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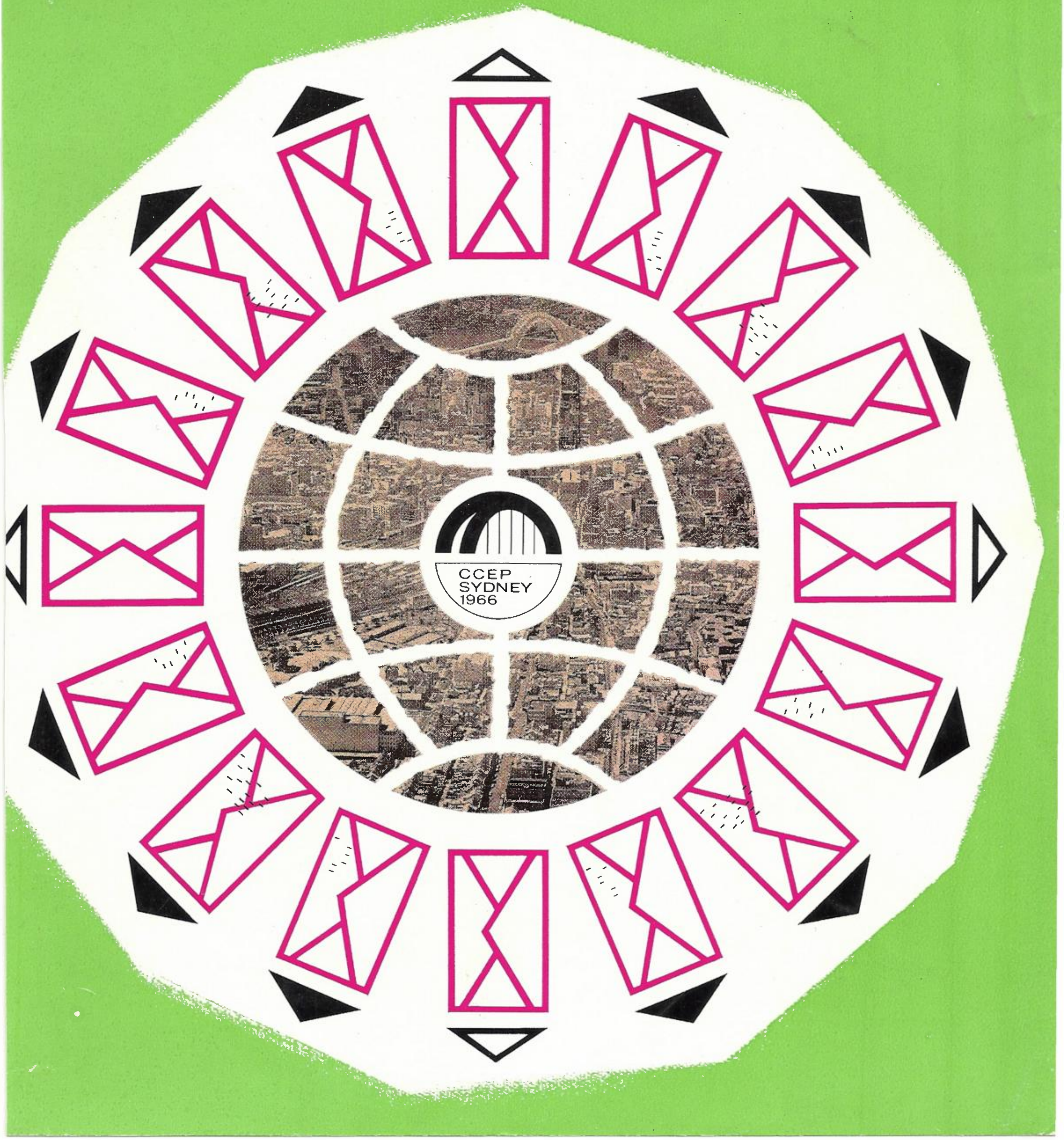
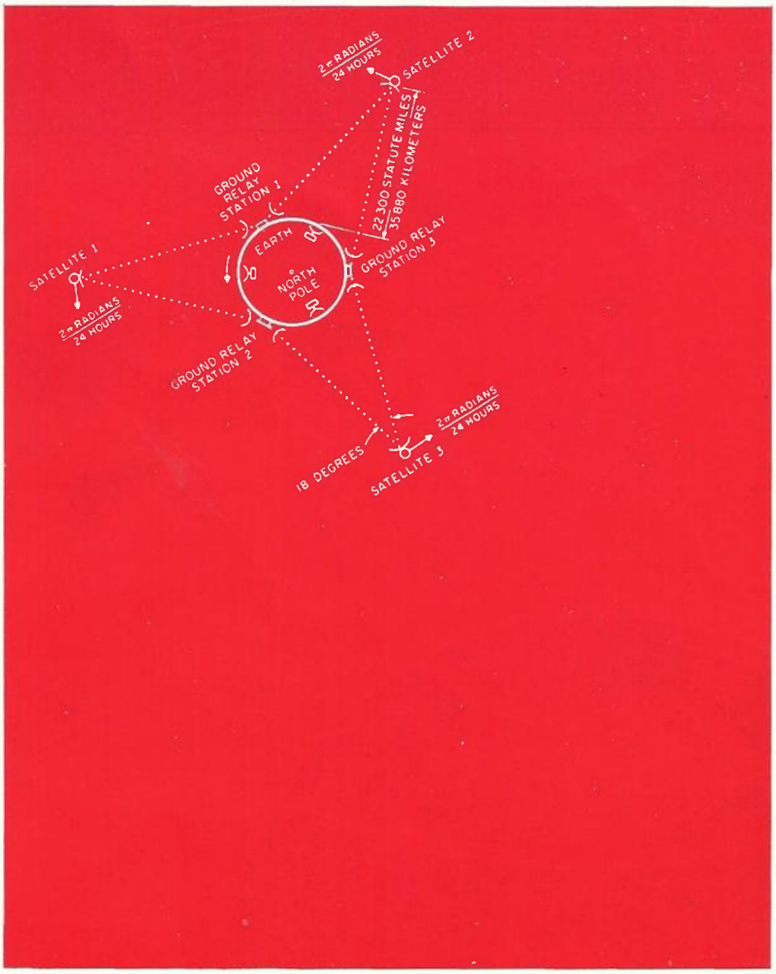
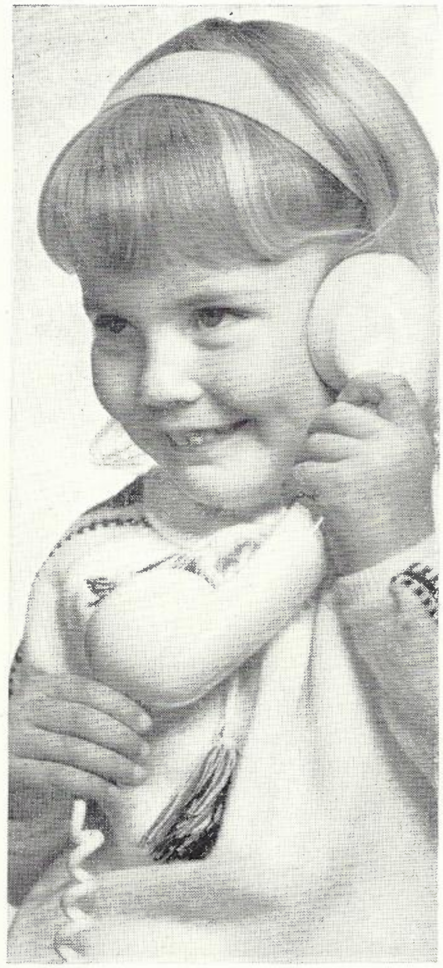




SATELLITE 2
2π RADIANS
24 HOURS
22 300 STATUTE MILES
35 880 KILOMETERS
GROUND RELAY STATION 1
EARTH
NORTH POLE
GROUND RELAY STATION 3
SATELLITE 1
2π RADIANS
24 HOURS
GROUND RELAY STATION 2
18 DEGREES
SATELLITE 3
2π RADIANS
24 HOURS



The
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of Australia

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CONTENTS

The Journal is issued three times a year (in February, June and October) by the Telecommunication Society of Australia. Commencing with Volume 15, each volume comprises three numbers issued in one calendar year.

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*For addresses see page 263

THE UNIVERSAL POSTAL UNION

*B. F. JONES, O.B.E., B.A., B.Ec.**

INTRODUCTION

November 1966 will be a land mark (or perhaps I should say a post-mark) in Australia's international postal history. During this month the first meeting of the Universal Postal Union ever to be held in Australia will convene in Sydney. The meeting is that of the Management Council of the Consultative Committee for Postal Studies**, the youngest permanent organ of the U.P.U.

Whilst the U.P.U. is now a specialised agency of the United Nations it is much older than its foster parent. In fact, for almost a century it has, as an instrument of international collaboration, operated to facilitate postal communications throughout the world. A tribute to the efficiency with which it fulfils its primary task is to be found in the fact that for many years now the reliability of the international posts has been taken for granted. Before the formation of the Universal Postal Union in 1874 international exchanges of mail were regulated by agreements concluded between individual countries, and the variety of rates and conditions of despatch caused difficulties both to the public and the postal authorities. In short, the international posts in the nineteenth century were very much in need of improvement.

EARLY HISTORY

The urgent need for international postal reform was recognised in several countries and two events in particular which took place early in the 1850's did much to influence official and public thinking in this direction. In 1851, an organisation called the "International and Colonial Postage Association" was formed in London with the aim of giving the world a simplified, uniform postal service with moderate postage rates. For the next few years the Association campaign-few years the Association campaign countries. The other event of significance was the formation of the Austro-German Postal Union which embraced the numerous German postal administrations of the day and illustrated the practicability of postal unity on a wider scale.

In 1863, Mr. Montgomery Blair, the Postmaster-General of the United States of America, organised an international postal meeting. Its purpose was to study the more important problems affecting international postal communications and to seek solutions which would facilitate postal relations between peoples and provide a basis for international conventions. Delegates from 15 European nations and the United States assembled in Paris and adopted a number of resolutions relating mainly to uniformity of weight scales, uniformity of postage and simplification of international accounting. The resolutions were not binding but they did simplify the many bilateral agreements already concluded between the nations assembled.

Whilst the climate was therefore favourable for the creation of an enduring International Postal Union it was not until 1874 that this move took place. In that year, mainly due to the efforts of Dr. Heinrick von Stephan, a senior officer of the North German Postal Confederation, the Swiss Government agreed to arrange an international postal congress in Berne. A draft convention drawn up by Dr. von Stephan was discussed, amended and finally accepted by the representatives of the 22 countries present, subject to ratification by their respective governments. This convention established the General Union of Posts; the name was subsequently changed at the Paris Congress of 1878 to the Universal Postal Union.

CONSTITUTION AND MEMBERSHIP

The present constitution of the Union provides that member-countries comprise a single postal territory for the reciprocal exchange of letter post, and specifies that its aim is to secure the organisation and improvement of the postal services and to promote in this sphere the development of international collaboration. The basic aim of incorporating the entire world into a single postal territory for the reciprocal exchange of mails found expression in the first convention and has remained a cornerstone of the organisation ever since.

The first convention guaranteed freedom of transit for mails throughout the territory of the Union. Each country was to charge uniform rates for well defined classes of mail (letters, postcards, printed papers, etc.) addressed to any other country and the apportionment of charges between sender and receiver countries was abolished. Each administration was allowed to retain the charges it collected subject only to the fact that it was obliged to pay, in accordance with fixed rates, any intermediary administrations which handled its mail in transit. The treaty also introduced arbitration for the settlement of disputes and provided for the establishment of a Central Office at Berne called the International Bureau, the expenses of which were to be borne by the member-countries. These basic principles remain an integral part of the Union provisions. Provision was made for a Congress to be held at least every three years with a view to perfecting the machinery of the Union, introducing necessary improvements and discussing matters of common interest. The interval between Congresses is now fixed at five years.

Under the first Convention, any country could be admitted to the Union upon application, subject to certain conditions of which the most important was prior agreement of any administrations having postal conventions or direct relations with the applicant country. In 1878, the Paris Congress modified the procedure for new admissions and the Universal Postal Union became an "open" Union which any country could join by simple unilateral declaration of adhesion, no prior consultation between members being required. However, it was once again a Paris Congress, this time in 1947, which further varied the membership conditions by providing that applications for membership required the aproval of at least two thirds of the countries constituting the Union. This condition was again modified at the Vienna Congress of 1964 to provide that any member of the United Nations may accede to the Union and that any sovereign country not a member of the United Nations must have its application approved by at least two thirds of the member countries.

The present membership of the Union stands at 128, Singapore and Malta being the two most recent admissions.

ACTS OF THE UNIVERSAL POSTAL UNION

Prior to the Vienna Congress of 1964, the principal Act of the U.P.U. was a Convention which covered not only the organic provisions but also the main conditions relating to all items of mail other than parcels. This Convention was supported by detailed regulations which, as the name suggests, dealt with the more detailed arrangements associated with international postal matters. However, at the Ottawa Congress, the Executive and Liaison Committee was given the task of redrafting the Convention, with particular emphasis on grouping into appropriate parts the organic provisions not frequently amended as distinct from the technical provisions. The results of this task were embodied in proposals submitted to the Vienna Congress and the revised texts were adopted with effect from 1st January, 1966.

The constitutional provisions of the Union are now contained in a Constitution with conditions relating to its application specified in General Regulations. In these two instruments are to be found articles dealing with conditions of membership, organisation of the Union, finances, the system of control through Congresses and Conferences, the function of the International Bureau, relationship with the United Nations and many other con-

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* Mr. Jones is Deputy Director-General, Postmaster-General's Department.

** In this article the English name is used. In the official language of the Union the French words Etudes Postales lead to the abbreviation C.C.E.P.

cil meets annually in different member-countries and is divided into three sections — technical, operational and economic. Working groups are established within these sections to undertake the studies agreed upon by the Council. Members of the Management Council may participate in the work of any or all sections, and the working groups may be supplemented by the participation of any other member of the U.P.U. who may so desire.

In the years since its creation, the C.C.P.S. has justified the hopes of its founders. A great deal of interesting and valuable work has been accomplished and a large current programme is receiving close attention.

INTERNATIONAL BUREAU

The third permanent organ of the U.P.U. is the permanently staffed central office known as the International Bureau. It operates as a clearing house for the documentation and interchange of information and consequently arranges for the assembly and publication of a mass of information of all kinds necessary for the efficient operation of the international postal service. It also provides the secretariat for meetings of the other organs of the U.P.U.

Although the International Bureau has no authority over Administrations, its special functions and experience do have the effect of giving considerable weight to its views, which are requested quite frequently. It is also on occasions called upon to act as arbitrator on disagreements between administrations.

The International Bureau is organised on a comparatively modest basis and the present approved ceiling of annual expenditure is 3,710,000 gold francs or approximately $A1,082,000. The expenses of the Union are distributed proportionately among member-countries according to the unit class to which they belong. The number of units of financial contribution range from 25 for countries in the first class through a progressively decreasing scale down to one unit for the seventh class. Any new country joining the Union is placed in its class for contribution purposes by agreement between the country concerned and the Swiss Government.

Whilst French is the official language of the U.P.U., provision exists for documents to be supplied by the International Bureau in any other language at the request of a member-country or group of member-countries. The costs associated with meeting such a request are borne by those members making it.

TECHNICAL ASSISTANCE

The U.P.U. participates in the U.N. development programme and is also active in other areas of technical co-operation such as arrangements relating to direct technical assistance between administrations, and the provision of expert guidance in the development of projects. It should be mentioned in this regard that the concept of technical co-operation has long been inherent in the Union's activities. This is illustrated by the procedure for disseminating information arising from studies made by members or from specific investigations undertaken by the International Bureau and the practice of members of exchanging both information and experts with neighbouring administrations. These practices and the tradition of co-operation provide a sound basis on which to develop means of meeting the greater and often urgent needs of modern times.

The Congress of Vienna in 1964 was particularly concerned with the organisation of decentralised vocational training and instructed the Executive Council and the Consultative Committee for Postal Studies to nominate four members from each body to form a Training Committee. This Committee is chaired by the President of the Executive Council and, after surveying existing training facilities and needs, is engaged in the planning of the training programmes required.

THE SYDNEY MEETING

As previously indicated, the Management Council of the Consultative Committee for Postal Studies consists of 26 member-countries and, because of the wide range of studies being handled, most countries find it necessary to send several representatives to meetings. This means the participation of up to 100 of the world's foremost postal experts at the Sydney meeting. The equipment installed in the new Mail Exchange will be of particular interest to them and of direct relevance to some of the studies being undertaken. The overseas visitors will, of course, have the opportunity of visiting the new establishment and discussing its operation with the appropriate local officers.

Apart from special papers on topical subjects to be delivered by several member-countries, some 20 studies will receive attention during the Sydney session. A number of these is directed to the subject of mechanised mail handling which, because of its magnitude, cannot be satisfactorily encompassed by a single working group. In the economic section, the complex and vital study of postal cost ascertainment is one on which a great deal of valuable work has been done and more is in hand. The topic of postal marketing, with its emphasis on the likely future demands, exemplifies the widespread acceptance by postal administrations of the need to forecast market trends. Economic aspects of basic air conveyance rates is another important study which will provide information designed to assist the next Congress to review the rates paid to world airlines for the carriage of mail.

The foregoing paragraph mentions but a few of the studies included in the following list which conveys some idea of the scope of the projects to receive attention at the Sydney session:

- Automatic facing for cancellation of items of correspondence.
- Mechanisation and automatisation of sorting of correspondence.
- Means of loading, unloading and routing mails.
- Mechanical conveyors for bags, bundles, etc.
- Mechanisation of parcel and packet sorting.
- Automatic issuing machines for postage stamps and stationery.
- Mechanical equipment for a large sorting office.
- Adaptation of layout of postal forms to meet office machine requirements.
- Mechanisation and automatisation of accounting.
- Multilingual vocabulary of the International Postal Service.
- Study of the present postal organisation in developing countries and ways and means of enabling these countries to provide an efficient service.
- Methods of handling peak traffic conditions.
- Organisation of despatch sorting.
- Organisation of work in the postal services.
- Conditions relating to the employment of postal personnel.
- Methods for determining staff strengths in post offices.
- Methods of development of postal technical progress in new and developing countries during the next 10 to 20 years.
- Determination of the cost price of the postal services.
- Study of the prospective postal market.
- Economic aspects of basic air conveyance rates.

CONCLUSION

As a participant in the work of the Management Council since its inception in 1957, Australia is conscious of the valuable contribution the C.C.P.S. is making to the development of all facets of both domestic and international postal services and appreciates the privilege of welcoming the 1966 meeting to Sydney. There is no doubt that this session will be a fruitful one and that it will fully uphold the proud tradition of service which is so much part of the Universal Postal Union.

During the two weekends that the overseas representatives will be in Sydney, they will be afforded some respite from the full schedule of meetings by excursions arranged to show them something of Australia in the limited time available. These excursions will include a trip to Canberra, embracing some of the surrounding country side, and shorter journeys in and around Sydney.

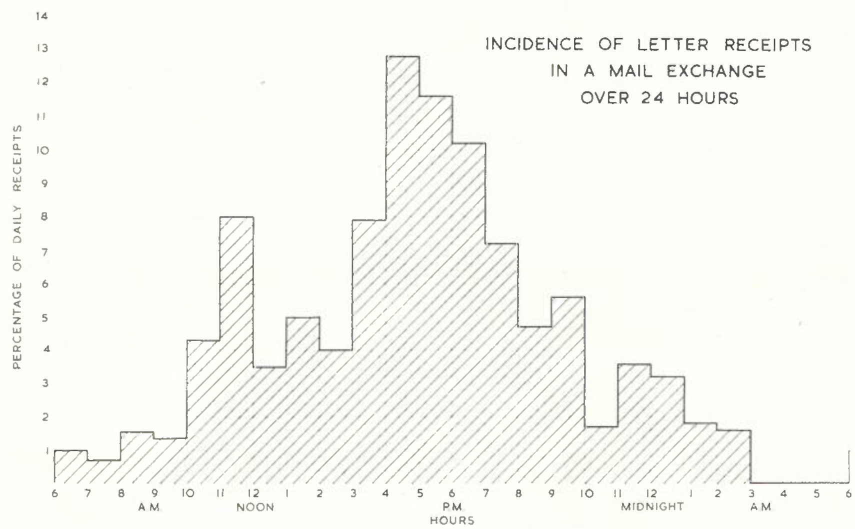

Fig. 2.

from Post Offices to the central mail handling centre, is processed and then despatched according to its particular destination. It is of interest to note that of mail processed —

35% is for suburban destinations
25% is for city destinations
22% for country destinations
14% is for interstate destinations
4% is for overseas destinations

The interstate component, generally speaking, is conveyed to the mail exchange in the State of destination where arrangements are made for it to be included in the despatch to the particular suburb, town or city concerned.

STANDARDS OF SERVICE

To maintain an efficient postal service, standards of service must be determined. This operates from the time the letter is cleared from the letter receiver, conveyed to the Post Office or Mail Exchange, processed through the various operations at that centre, transported to the Post Office of destination and finally delivered by the postman.

Speaking generally, within the whole capital city area, which in the cases of Sydney and Melbourne each cover about 650 square miles, same day delivery is provided for letters posted in the morning, and next morning delivery for letters posted in the afternoon and evening. Three deliveries a day are provided in the inner city area and two deliveries in most suburbs. Next morning delivery of letters to interstate destinations is provided in most instances. Similarly, standards have been determined for other categories of mail such as newspapers, packets and parcels.

Scientific sampling techniques are used to check the grade of service actually given and information obtained from such checks is used to highlight and remedy weaknesses.

The postal service must meet our customers' demand but, in so doing, we must provide a service which is reasonable, from both the cost and service standard points of view, and reliable. In some cases in the past, we have provided a service of a standard which is higher than the customer really wants. To enable us to know what the customer does want, and is prepared to pay for, surveys are now undertaken.

Standards of service must be reviewed from time to time. Requirements and habits of the public change and it is essential that the Post Office be aware of the current needs of the customers.

SOME PROBLEMS IN MAIL HANDLING

Inherent in mail handling are the problems of peak traffic so well known to communication engineers. These seasonal, monthly and daily peaks cause many difficulties, which increase rapidly with increase in volume. Fig. 2 gives a general indication of the spread of traffic through the hours of a day in a typical mail exchange.

The "cut off" time in a mail exchange for afternoon suburban delivery is approximately 11.30 a.m. Despatch time for this delivery is approximately 12.45 p.m. This means that there is $1\frac{1}{4}$ hours for the processing of this mail. If the volume of mail for this suburban delivery doubles and if the "cut off" and despatch times remain constant (and any variation in these times has a marked effect on the standard of service), twice the volume of mail must be handled within the same given time. Bearing in mind the peak nature of the traffic input, if the staff is increased to handle this increase in mail receipts, the amount of ineffective time over the stretch of the shift can be increased substantially.

In addition, the spread of the metropolitan areas means that the mail "pick up" runs are attenuated and transit times between the mail exchange and the suburban post offices are becoming greater.

Management has, of course, over the years, introduced innovations, modified procedures, and resorted to a number of expedients to retain the

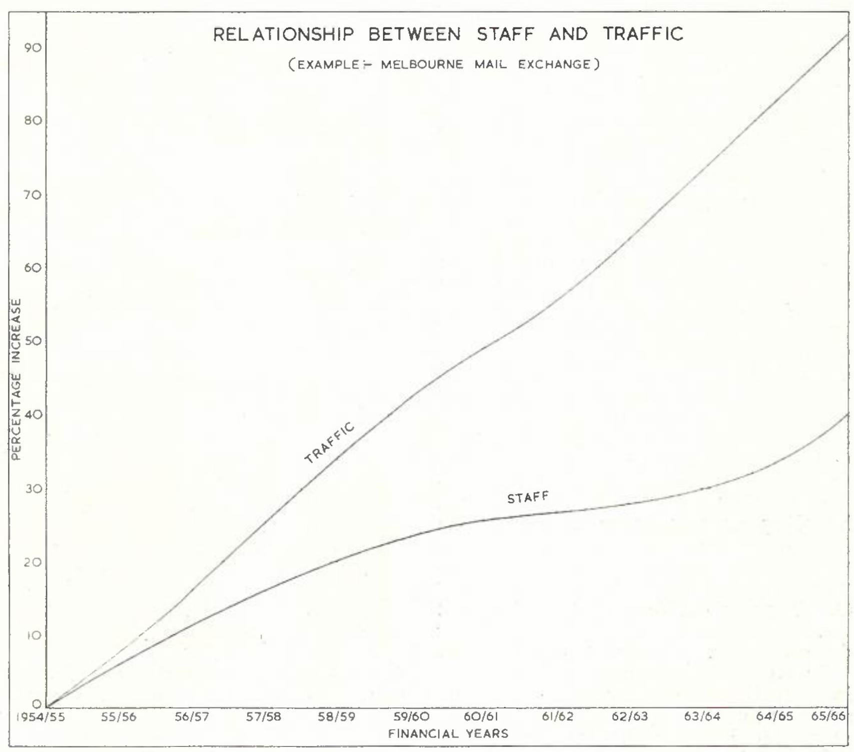

Fig. 3.

estimated that these figures will double over the next 20 year period.

It is the rapid advance in the field of electronics that has provided the tools for a major break-through in our processing concept, particularly for the treatment of letters. The installation of the letter coding system is the culmination of the first stage of plans to mechanise to the maximum extent possible the processing of letter-form articles. Details of this system have been dealt with in subsequent pages of this Journal. It is, however, relevant to note by reference to Fig. 4, the progress since 1950 when upright sorting presses were still in use throughout the Commonwealth. Their use for primary and secondary sorting was replaced by letter handling machines which are now in turn gradually being replaced by coding and decoding machine systems.

Our problems do not end with the placing of a highly modernised letter handling system into service. Management must develop new skills and recognise too that operations now require changed disciplines. It must foster a closer relationship with the postal user, particularly large business concerns, to ensure that, wherever possible, postal articles passing through the post are suitable for machine or automatic processing. Already new sections of customer education and correction are operating in an endeavour to achieve these ends.

We will be obliged to develop user specifications and modify our rules and regulations as may be necessary to obtain maximum operating efficiency from our equipment. A committee has already been convened by the Standards Association of Australia to prepare an Australian standard for envelopes. When issued this will be an extension of the requirements now being expressed by the Universal Postal Union. The issue of further Australian Standard Specifications will be necessary to eliminate the use of coloured invoices and other envelope insertions on which the address must be read through a panel. We must also endeavour to bring some influence to bear on the size of cheques and documents, etc., designed for transmission through the post.

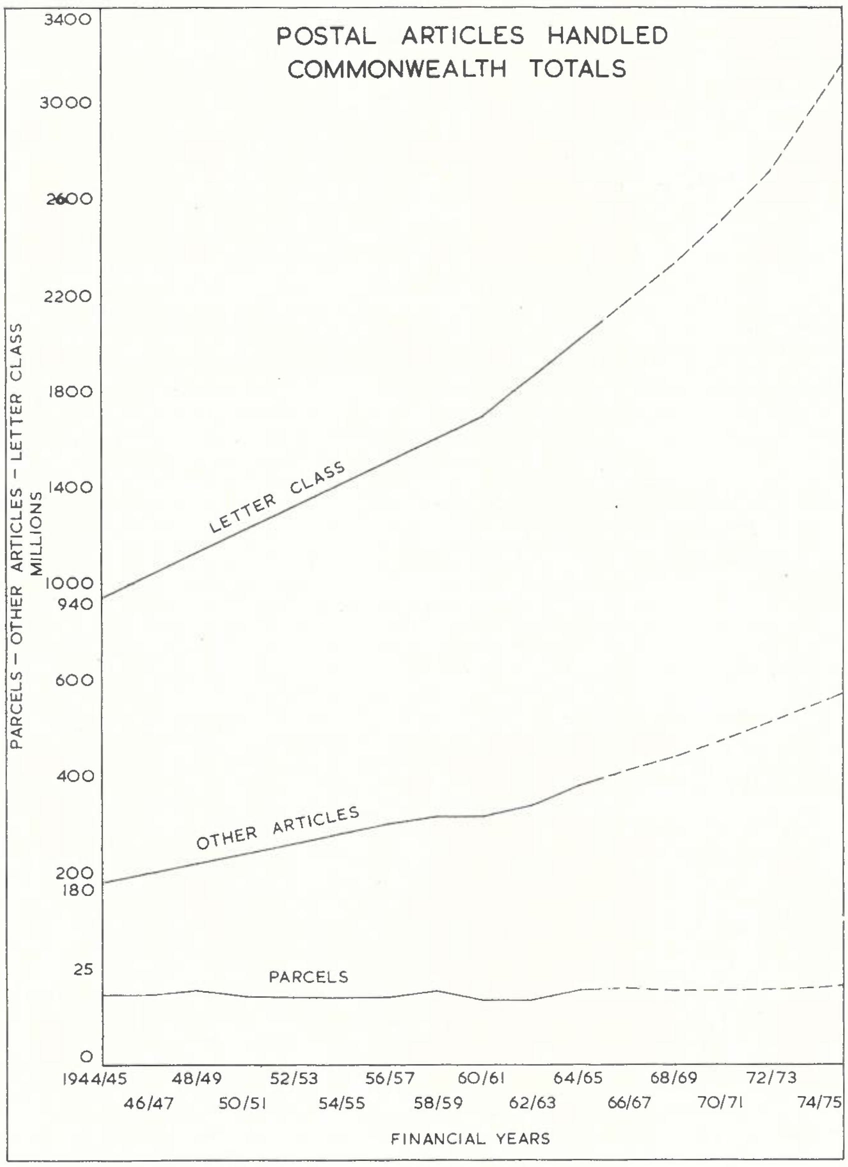

Fig. 5.

NEED FOR A MEASURE OF STANDARDISATION.

The necessity for the introduction of a measure of standardisation of mails, particularly letter mail, can be illustrated by reference to the process of "facing up" of letters. Letters from letter receivers arrive at the mail exchange for processing. In the past, before this mail could be sorted, staff had to arrange the letters so that all the stamps were in the top right hand corner. The letters were then fed through a stamp cancelling machine.

This "facing up" process was very costly, and is one of the processes which have been mechanised. Letters, as you can well imagine, are of various types, sizes and shapes. To "face-up" a square envelope automatically is very much more costly than to "face-up" a rectangular envelope because, on a square envelope to be "faced up", a stamp can be in any one of eight positions, whilst on a rectangular envelope, it can only be in one of four positions. (See Fig. 6.)

In addition, if the length of an envelope is considerably greater than its width, the problems of conveying that letter automatically through the various channels are reduced. It is for these reasons that the Universal Postal Union has standardised certain basic requirements for envelopes; one of which is that the ratio of length to breadth should be at least $\sqrt{2}:1$. In any high speed automatic system, some measure of standardisation is inevitable.

DEVELOPMENT OF THE AUSTRALIAN SYSTEM

Although the system used for the coding of letters is explained in detail in later articles, I would like to briefly indicate the type of problems that were encountered in its development. The manual system consists of a series of operations where a Mail Officer reads the address and sorts the letter into a particular slot or pigeonhole, depending on its destination. The letter, generally, is conveyed by belt to the next sorting stage where a similar manual operation takes place. After a letter is sorted on the final divisions, it is despatched to its destination. Most of the letters are handled two or three times.

THE DEVELOPMENT OF THE A.P.O. MECHANISED MAIL HANDLING CONCEPT AND OVERSEAS TRENDS

*V. St.G. MAGNUSSON, S.M.I.R.E.E.(Aust.)**

The Australian Post Office concept for the design and application of machines for the processing of mail has been based on observations made over many years on methods of handling mail, the physical and other characteristics of articles and the labour components required in the various work areas. The most important factor influencing present day thinking is the rapidity with which mail processing costs are increasing.

Basically, the conditions under which mechanisation in the postal service becomes most efficient are when the desired standard of service to the community is provided with the greatest economy of operation. This broad statement assumes that full consideration has been given to such factors as staff comfort and the desire to eliminate burdensome tasks.

Insofar as the standard of service to the community is concerned, there could be two conditions under which an Administration accepts the principles of mechanisation. It could be that the present standard of service is satisfactory and that the reason for mechanisation is to reduce the costs of providing service; or it may be that mechanisation is necessary to upgrade the standards of service. There could conceivably be a further condition where it becomes necesary to re-adjust service in a downward direction. This would apply only in various parts of the total area over which the service is given and would only mean a reduction in service standards for certain groups which at present enjoy a higher standard than others.

This would suggest that service standards should be assessed and determined as an independent factor regardless of the method of handling mail. This in itself is a complex problem, having many facets, some of which are the determination of boundaries for country and metropolitan delivery; the form of inter-office transport employed; and the time of the day when the first letter delivery is to be effected. Once the standard of service to be provided is determined as a fundamental fixed condition to be met for a period of time, then all other calculations or comparative economic studies should be developed to meet this condition, whether the methods of handling remain manual or are mechanised. It is, of course, realised that variations to any so-called fixed service standard will occur from time to time, but that the major variations which are within the control of Administrations should, if possible, be planned to provide for a definite period of time.

The processing of mail in itself could be regarded as a relatively simple problem, but the operation tends to become complex when large volumes of mail are to be treated. For convenience of handling, articles of mail must be divided into several characteristic groups each requiring its own unique machine system. Processing must also be governed by the time elements which must be observed to provide service. There is also the problem of documentation and secondary activities associated with the handling of large volumes of mail.

It becomes obvious in any analysis of the ratio of staff to traffic load that a proportion of the operatives must be occupied on activities other than the prime process of sorting. It seems essential, therefore, in the attempt to reduce the cost of the sorting process, that we should also consider the labour expended in other areas. This then highlights the fundamental need for the co-ordination of the output of operatives engaged on the same sorting process and the automatic transfer of articles from process to process, particularly in large mail exchanges. It also points to the basic need to think in terms of machine systems rather than of machines. It is most unlikely that machines designed to process low volume flow can be adapted for use where peak hour volumes are considerable. However, the converse, that design should be based on the evolution of machine systems the elements of which could be utilised at centres of low volume peaks, could be true.

The second important conclusion is that design efforts should not contemplate the use of machines or systems which in themselves separate articles into many directions. If the natural evolution is through mechanisation towards automation, some balance should be made between the number of primary separations as against those required subsequently.

With few exceptions, the trend until recently has been to develop letter processing machines with a single, or at most, a limited number of associated operating positions. These may enable letters to be divided into a considerable number of directions but where two or more machines would be required to meet peak load conditions, there is no ready means for automatic co-ordination of outputs. (See Figs. 1, 2 and 3.)

It seems evident that the solution is to develop systems in which the coding desks are self-contained and detached from the sorting or decoding operation. This is the basis for development in West Germany where there is a system utilising 14 coding desks which feed to several decoders.

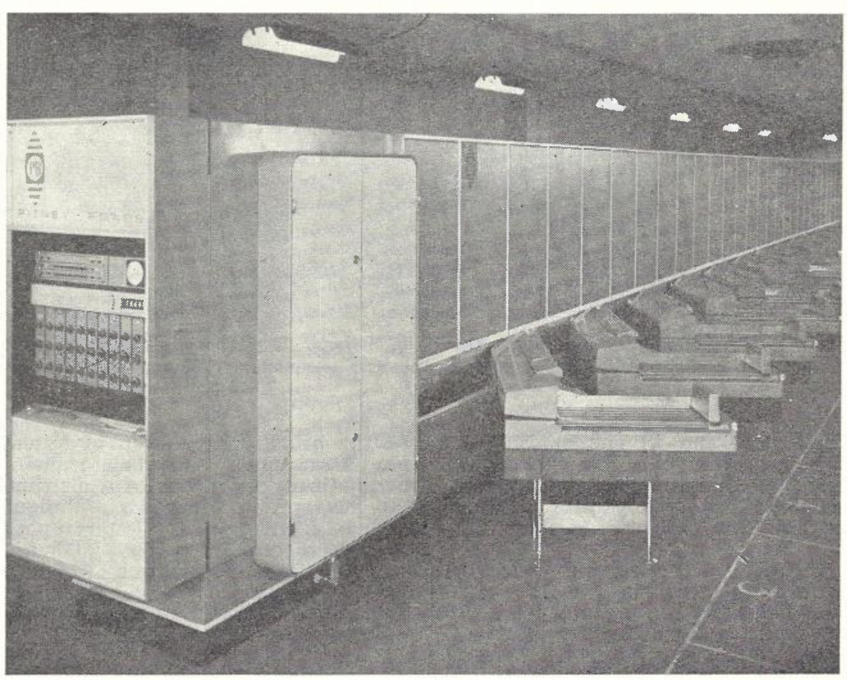

Fig. 1 — Sorting Machine of a Type Used by the U.S. Post Office. 12 positions — 300 separations. Manual feed to operators — manual clearing.

* Mr. Magnusson is Deputy Assistant Director-General, Postal Services Division.

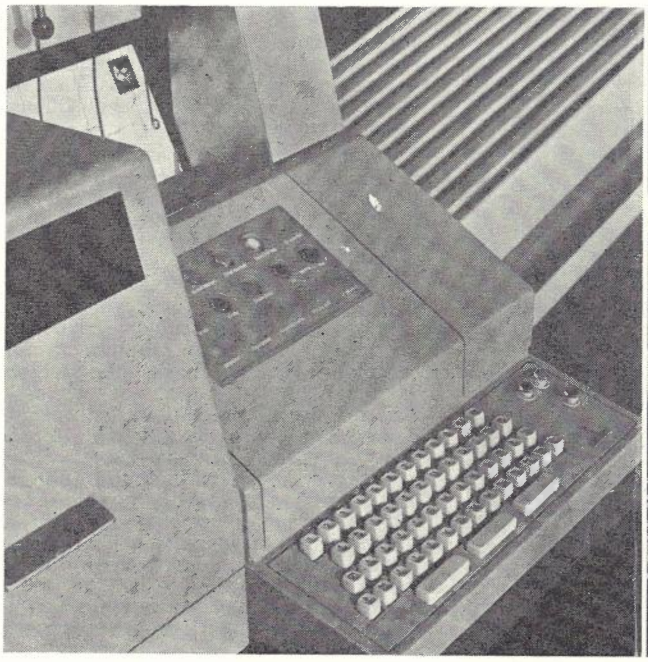

Fig 4 — Coding Desk. One of 14 used in conjunction with Decoders shown in Fig. 5. Automatic infeed and clearance.

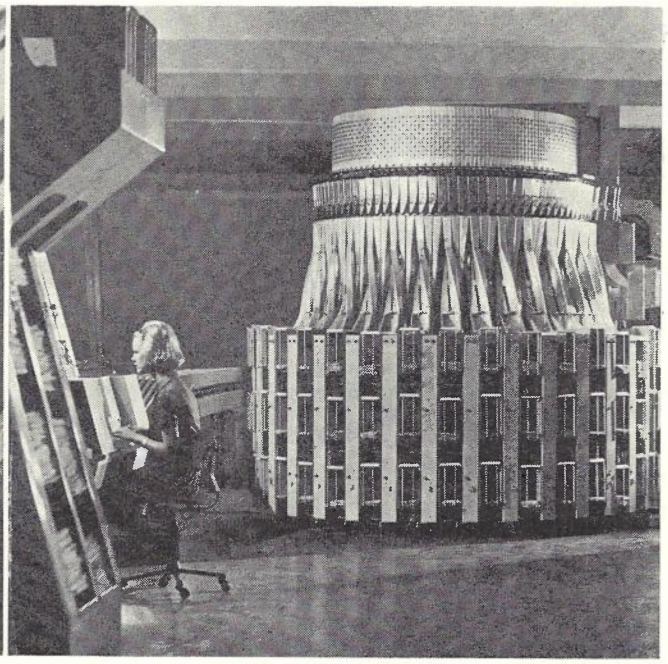

Fig. 5 — Decoder Used in Conjunction with Coding Units shown in Fig. 4. Automatic infeed — manual clearance.

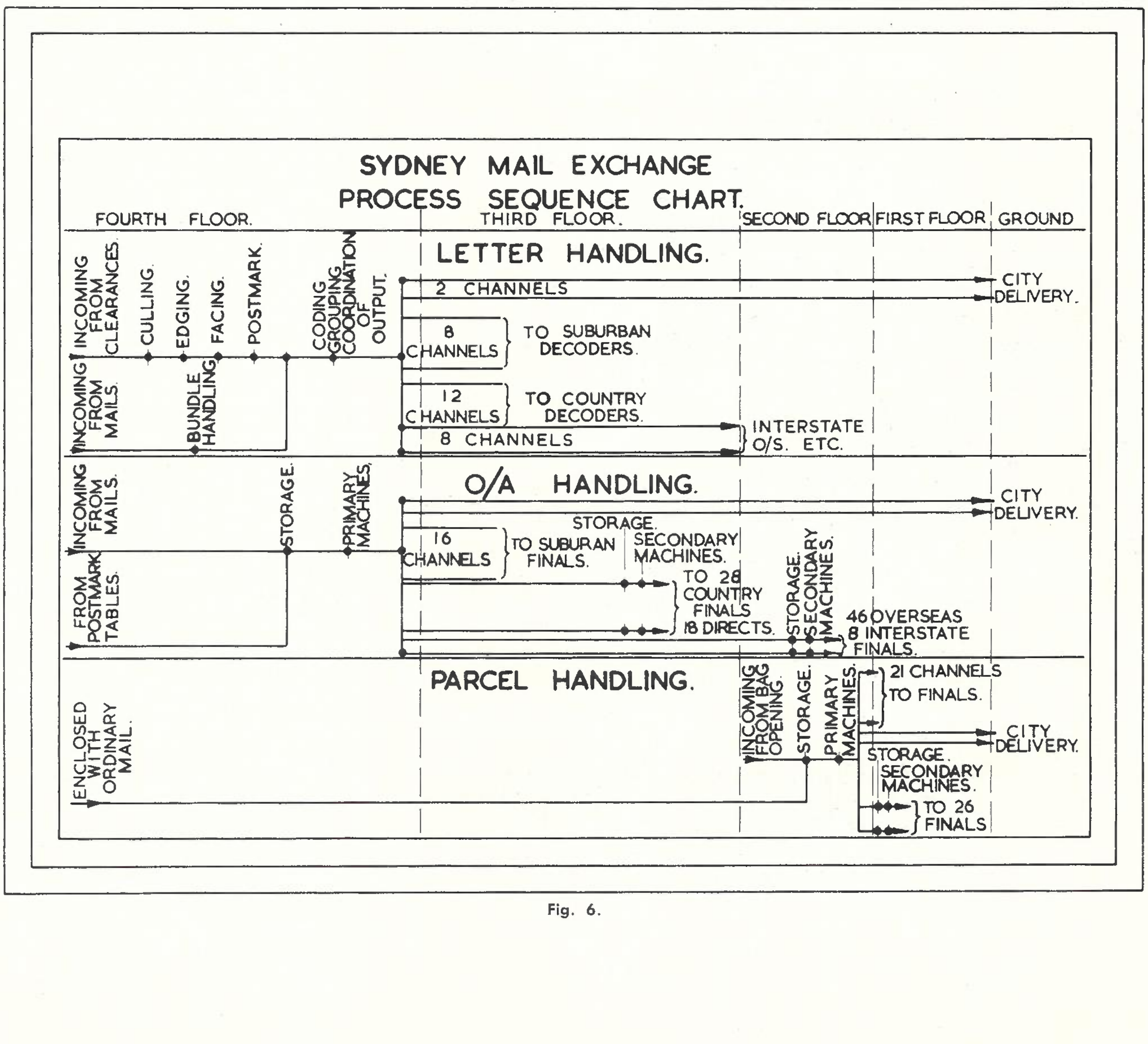

Fig. 6.

Fig. 9 — Parcel Sorting Machine — Using Tilted Tray Method for Parcel Diversion — U.S. Post Office.

Fig. 10 — Parcel Sorting Machine Using Sweeps for Parcel Diversion — U.S. Post Office.

It is essential that the total transit time for each processing line including the conveyance of bagged mail from and to the dock area be kept at a minimum. It was for this reason that the bagged mail handling system described in this issue was designed, in order that the average transit time for outgoing bags may be kept at an average of 90 seconds. It follows, therefore, that sequential operations should be adjacent or, where possible, in a vertical line between floors. Obviously, the length of time required to convey mail from point to point has a bearing on peak staff requirements. This factor must also be taken into consideration when determining equipment provision and the capital expenditure involved.

It should be mentioned, however, that peak period volumes are influenced by several other factors, some of which are under the control of management. In comparing peak demand, it must be borne in mind that, unlike automatic telephone exchange traffic, mail can often be readily held in store for varying periods without affecting service standards.

It is, for instance, important that machine designs be such that equipment may be readily installed in most buildings particularly existing sorting offices. This condition requires that equipment must be unit constructed and light in weight. Heavy construction is unnecessary, and costly, having regard to lightness of the loads the equipment is to carry. Furthermore, equipment designs should take into account the need for economy in the use of floor space. Considerable attention has been given to the appearance of machines and generally form has followed function. Surface finish has been given due importance, working surfaces are of plastic materials, and pleasing colour treatments have been used.

It is important, too, that designs take into account future developments not only to meet expanding traffic requirements but changes that may be dictated by progress in technology. Obviously a modern letter handling and distribution system should be designed so that letters, if electronically scanned and coded, may be inducted into the main flow. This is of particular significance with the A.P.O. concept where coding identifies the route as well as the Post Town.

Design characteristics must, of necessity, be such that maximum work outputs are possible. The study of human engineering problems is therefore important. The effort required to complete each unit of work should not contain avoidable expenditure of energy. For example, where the sorting operation is manual such as the sorting of O/A.'s, the optimum number of primary separations is 24. To go beyond this number would reduce the hourly rate of sorting and increase the possibility of mis-sorting.

where volumes and numbers of articles passing through the Mail Exchange may be automatically recorded for examination or analysis. Access to reliable statistical information is essential to officers concerned with traffic management and staffing arangements.

Provision has been made in the circuitry of each machine system for the tapping of leaks for both supervisory control and the centralised recording of statistics. Electronically actuated units which can be fitted to conveyor runs have already been made for the weighing of mail matter in flow.

As the letter handling system required new methods of work processing, it was necessary to extend study into other technical fields. One interesting example is the application of the science of ergonomics to determine the location of the keyboard at coding positions. The keyboard is located at approximately waist level and is adjustable in both the horizontal and vertical directions. The operator's seat is fitted with a rest for the left arm only.

Many keyboard layout arrangements are possible. Some similar to typewriters fitted with up to 50 keys are in use overseas. A keyboard having only five keys has also been devised and used to provide for coding systems with limited application. A further variation is the use of two sets of five keys, one for each hand. This arrangement required a key in each set to be pressed simultaneously to register a character.

The development of a standard keyboard arrangement for A.P.O. use, was a most difficult problem, involving finally, tests to determine mental reflex actions of keyboard operators. These tests did not favour the use of keyboards where the operation required a finger of each hand to depress keys simultaneously, as even slight variations in timing caused errors. Such errors would increase where the keyboard is to be used for numeric as well as alpha codes.

The keyboard finally adopted as standard is based on one developed for use with tabulators and computers. On this particular keyboard, alpha characters are registered by depressing two keys simultaneously with the thumb and index fingure of the one hand, i.e., a one-handed keyboard. To ensure efficient keying operation, the circuitry is not operative until the pressure is removed from the keys. By this means, tension on the operator has been removed. To ensure that touch coding commences early in the training period, the keys have not been individually designated. However, certain key groupings have been given a distinctive colouring for ready identification and as an aid to quick memorising of key locations. Fig. 12 shows the keyboard adopted by the A.P.O. Fig. 1 on Page 216 gives details of layout and usage.

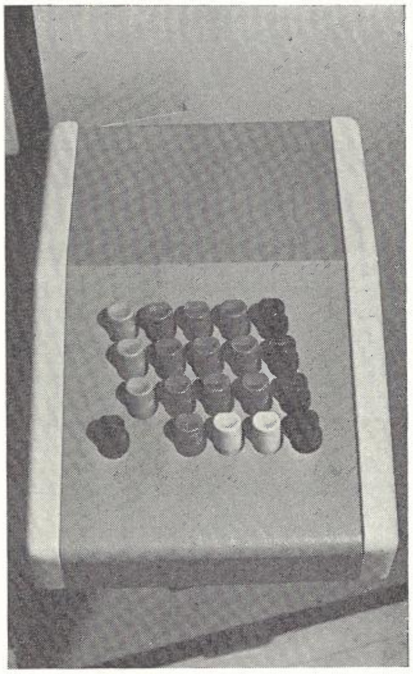

Fig. 12 — Keyboard Adopted by the A.P.O. for the Coding of Letters.

Again to ensure that there is no unnecessary mental strain or undue demand on operators, the development of machines which require the operator to work in rhythm with its movement has been avoided. Whilst earlier machines developed overseas, embodied this method, it has been generally discarded in later machine designs.

It is appropriate to make reference in this article to the code systems devised for use by the A.P.O., as it has had a direct bearing on the type of keyboard design. The development of a code is, of course, essential if electronic equipment is to be employed for automatic sorting. It provides a means whereby the keyboard operator may cause each envelope to be correctly code marked for subsequent sorting by an automatic process.

There are at least three methods of coding which may be devised for the purpose, i.e.:

(i) Extraction coding

(ii) Public Coding

(iii) Keyboard coding.

These methods, each of which is made use of by the A.P.O., are discussed in the following paragraphs.

Extraction coding is based on the selection of alpha characters from the destination name included with the address. The determination of the optimum code pattern is a difficult problem, as one of the disadvantages of extraction coding is the number of characters which must be taken from the place name if the number of ambiguities is to be kept within reasonable limits. Ambiguity is a condition where the extracted characters and their sequence are the same for two or more localities. In Australia, it has been found necessary to extract five characters with the particular order of selection being the first, second, fourth and last two.

Several simple rules are necessary when using the code as some place names may not contain five characters, whilst others may consist of two words. Other rules are also necessary to avoid ambiguity. In total, a keyboard operator is required to memorise eight rules when using the extraction method for coding letters.

Public coding is a system which can be devised for use by the public when addressing mail. The value of public coding depends however on the degree of co-operation obtained from the users of the postal service. The A.P.O. has allotted a unique four-digit combination to each Post Town in the Commonwealth, the first digit representing the State in which the place name is located, i.e., 2 for N.S.W., 3 for Victoria etc. There are sufficient spare number combinations to meet development in New South Wales and Victoria for at least 20 years and for an indefinite period in other States. It is possible to extend the code to 5 digits should future development demand such a course. This could be done with no appreciable inconvenience to the user.

Numbers from the bracket (001-999) have been distributed to localities on a broad geographical basis. In New South Wales, for example, the following areas are observed:

Area	All N.S.W. number Combinations prefixed by "2"
Suburban	001 - 249
Country	
North	250 - 419
East	420 - 559
South	560 - 739
West	740 - 899
Spares	900 - 999

The adoption of the numeric code has provided an additional aid to the sorting process as digits can be keyed with one finger more readily than alpha characters. Futhermore, only the last three digits need be fed into the system when coding for intrastate Post Towns, the first digit only being required when coding for interstate destinations. A numeric code also provides an aid for the manual sorting of non-letter form articles.

Obviously, a public code could be made up of alpha characters or a combination of alpha and numeric digits. Codes of this nature would not meet the requirements of future planning, particularly with respect to the eventual introduction of automatic reading of addresses by scanning.

THE LETTER HANDLING SYSTEM

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INTRODUCTION

Nearly 160 years before Rowland Hill introduced the first postage stamps, a privately run post was in operation in London, with up to 12 deliveries a day in the business area. Before Hill's reform of the postal service, letters were being sorted into upright frames very similar to those still used in some areas of mail handling.

However, rapid growth of the mail service and the huge volume of articles handled at mail exchanges have made it imperative to mechanise the processes wherever possible.

For many years the Australian Post Office has had machines designed to collect the mail after sorting into its groups, and deliver it to a point for bagging or subsequent sorting, to minimise congestion and labour. These machines provided a 28 break, with up to 30 operators per machine. Letter transfer systems were also provided to deliver the primary breaks to the secondary sorting areas elsewhere in the building.

It had been envisaged for some time that these so called "flat top" machines could be used for the basis of a coding system, where the need for the sorter to reach across the field and drop a letter into the selected destination is replaced by a mechanical device, and the letters are fed singly to the operator, who sorts from a keyboard. This technique has been developed and used in principle in the letter coding system, and a 30 break primary sort is achieved before any code marks are applied to the letter.

This article will describe the Letter Handling System and equipment installed now at the Sydney Mail Exchange.

THE DEVELOPMENT OF THE SYSTEM

The Present System in Australia

Very generally, any article containing correspondence is classed as a letter in Australia. In common with all other administrations, the Australian Post Office is faced with the task of handling a huge range of sizes and shapes which pass as letter class mail. However, all letters within the limits of 10 in. long, 5 in. high and 3/16 in. thick are eligible for "all up" air delivery within the Commonwealth at no extra fee, and endeavours are being made to introduce standard envelope sizes, along with other Universal Postal Union member countries. All letters falling outside the above limits are classed as "large letters", and given separate treatment.

In the present system, and for that matter in the coding system, letters can enter the mail exchange in three main categories; ex-mails, pillar clearances and bulk. The ex-mails are letters which are faced and cancelled and stored into locality bundles in Post Offices within and outside the State. These are extracted at bag opening positions and the bundles separated into those requiring primary and other stages of sorting. Pillar clearances are those letters collected in street pillar receivers, and upon entering the mail exchange they require culling to remove the oversize articles, and facing and cancelling to orient the addresses and cancel the stamps. Bulk letters brought in by large users and firms are generally faced, and often prepaid requiring no cancelling.

After the above processing these three groups are now ready for sorting, and are transferred to the primary sorting machine (the so called "flat top" mentioned earlier). These machines seat up to 30 sorters, who drop letters into slots in a sorting field to up to 28 separations. The letters fall onto 1 in. wide belts, and travel upright on their bottom edge to stackers at the end of the machine, or chutes which deposit them on to the horizontal aggregating conveyors of a letter transfer system. From the primary the letters proceed to secondary and tertiary sorting stages, again equipped with sorting machines similar to the primary.

The Coding System

In common with overseas administrations, the Australian Post Office has realised that as the volume of letter form articles grows each year, it becomes imperative to automatise the process and eliminate where possible the secondary and tertiary sorting processes.

The Australian system has been developed to handle the full letter load of the Sydney Mail Exchange, with automatic transfer between coding and decoding machines. A semi automatic feed system is used to transfer mail from cancelling and bundle handling positions.

The system utilises a 30 separation primary break in the coding machine itself, with transfer conveyors aggregating the output of all coding positions and automatically stacking it at decoding machines. The coding machines or desks are grouped in suites of 30 operator positions, with a total of 5 suites, or 150 positions. At the expected output rates of 2000 per hour from each operator, peak loads of 300,000 letters per hour are anticipated.

The memory system, which accommodates coding information for a Commonwealth-wide scheme uses a magnetic drum, and is only connected to the primary machines. Thereafter subsequent sorts are carried out at decoding machines from the code bars imprinted on the back of the letter at the primary coding position.

At the decoding machines, of which 20 are used, automatic stacker-feeders collect the mail from the transfer system and pass it through reading heads running at a speed of 7,000 per hour. Up to four of these heads can be fitted to a decoding machine. Initially three heads are being supplied on each of the eight suburban decoders, and two heads on each of the 12 country decoders, giving a total maximum output between 160,000 to 170,000 per hour for each section. Letters to interstate and city destinations are carried by transfer and automatically stacked on large capacity stackers each holding approximately 3,000 letters.

Early Development

Although the basic concept of the coding machines themselves was well formed in the minds of the Post Office engineers, the construction of trial models was necessary to establish whether these concepts could be developed into a full scale coding system. The principle of double viewing appeared to have been already established by other administrations, including the B.P.O. in their Single Operator Letter Sorting Machine. (Refs. 1, 2 and 3). The first Australian model was constructed using a sideways transfer from the first to second viewing position, to reduce machine height, but the width and unsatisfactory presentation to the operator made the upright console the obvious selection. However the model did give valuable information on presentation, keyboards and operator speeds. Since the philosophy of the system depended on the primary break of 30 at the coding machine, a number of models were made of this equipment, and tests carried out on them.

The problems met by the contractor, Telephone and Electrical Industries in the final development and manufacture of this equipment are described later. It might be added here that many of the valuable refinements to the system, such as the stacker feeder, and stream feed system, were incorporated as the development progressed. Models of the

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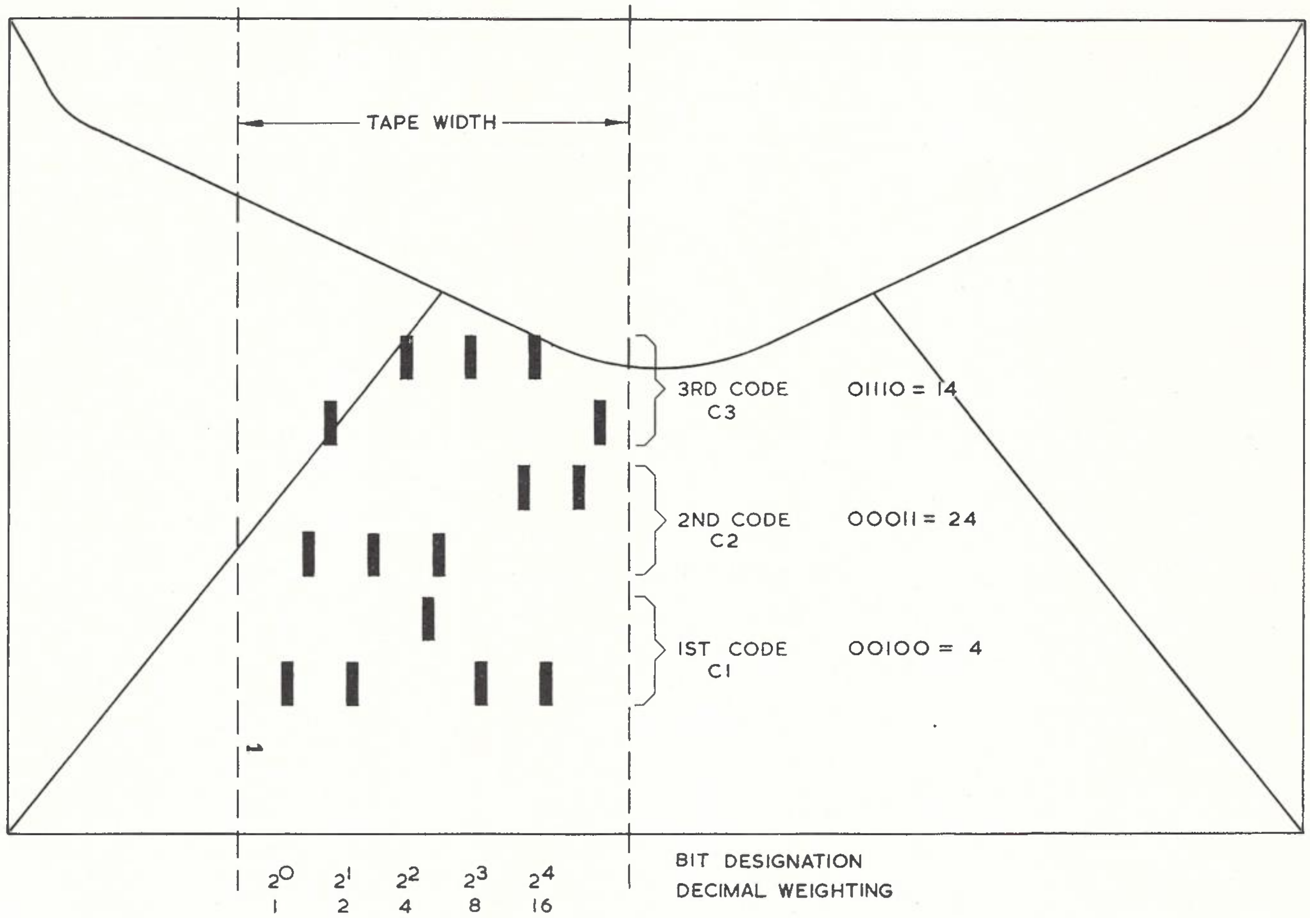

Fig. 2 — The Code Bars on the Envelope.

The keyboard is jack in, jack out for easy maintenance, and can be rotated, raised, or lowered to suit the individual operator. The position of the board differs from that used when the board is on a punch card machine, but was adopted after human engineering studies into the correct placement of this type of board with respect to the operator's arm and body. (Ref. 4). The keyboard is a modified board supplied to local specifications by ICT in the U.K.

Code-Marking the Letters

Letters are code-marked on the back of the envelope approximately one inch in from the left hand edge as viewed from the back, and about half an inch up from the bottom. (See Fig. 2).

The code marks are transferred from a reel of mylah tape 1½ in. wide by heated pins. The luminescent material is of a zinc sulphide base, fluorescing in the green range under ultra violet excitation, and is retained on the tape by a wax composition. The excitation period is approximately 50 millisecs and the signal is read on the decoder 25 millisecs after excitation is removed. The reels are 6 inches in diameter, and are sufficient for approximately 170, 000 letters.

It will be noted that the horizontal rows of codes are slightly staggered within the width of the tape. With this arrangement the tape is moved on for only the height of a single row (3/16 in.), after each printing, i.e. each letter, giving maximum tape utilisation.

The code marks can appear in up to six horizontal rows, each pair of rows representing a code, shown as C1, C2 and C3. The code marks are complementary, the upper row representing a "1" and the lower row an "0". This system gives a constant check on the printing mechanism and circuitry, as letters not bearing complementary code marks are rejected at the decoders. A figure indicating the originating coding position number identifies the faulty machine to facilitate maintenance. This can be seen on the left below the first row of codes on Fig. 2. The decoding equipment is designed to use 29 combinations of the available 32 derived from this five bit code to the base two, plus one reject.

With this arrangement the Sydney suburban despatches, which amount to just under 200 separations, can be handled on one pass with the eight decoders provided, i.e. 8 x 29 = 232. Therefore all Sydney suburban letters sorted locally require only the first code row (C1). (See Table 1).

For the New South Wales country, provision has been made to give up to 1020 separations. This is accomplished by allotting on each decoder: stackers 1-27 for first pass, stacker 28 for second pass run number one, and stacker 29 for second pass run number two, or 27 + 29 + 29 = 85. With 12 decoders this totals 1020 code combinations. The large country centres comprise the majority of the letters which can be extracted in the first pass (12 x 27 = 324), and the medium and small centres in the subsequent second passes (12 x 29 = 348).

Since all suburban, and the larger country centres can be extracted in the first pass, it is expected that around 80% of letters going through the primary coders requiring code marks will only receive one code row (C1).

The primary and subsequent separations are given in Table 1.

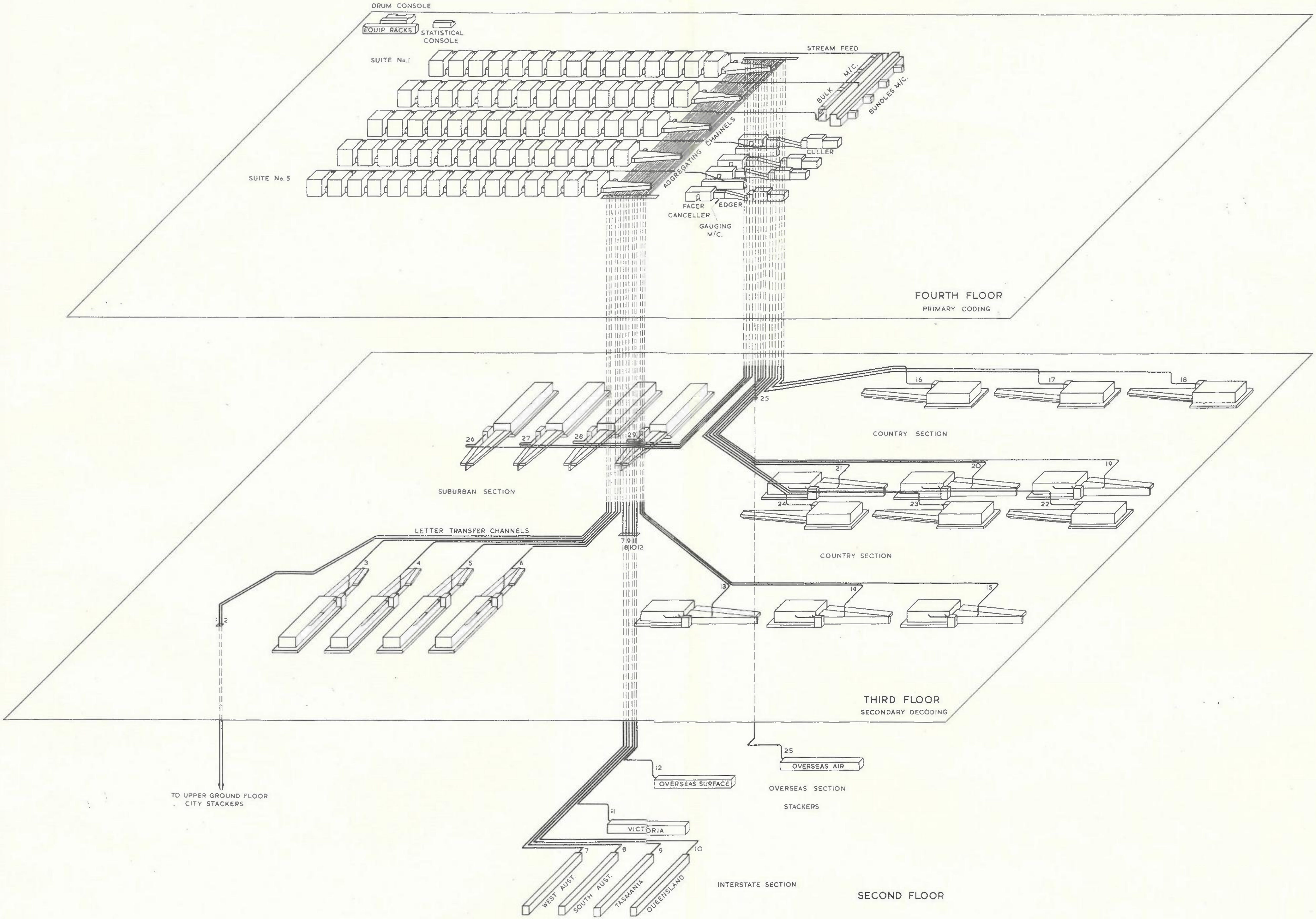

Fig. 4 — The Letter Coding and Decoding System.

than letters, and oversize letters is carried out manually on the culling belt, which is moving slowly at about 3 feet per minute. The culled articles are placed into hoppers, shown in the figure and carried by conveyor to their processing area. In the culler itself, shown in the middle right of the picture, the letter flow is evened out before passing on to the rising edging belts. The slope and speed of these belts causes letters to align themselves on their longer edges and it is in this area initially that the Australian Post Office is anxious to retain the minimum ratio of 1 is to 1.6 for envelope sizes. After leaving the rising belt, the letters are fed into a gauging machine, which checks each one for stiffness, thickness and size, before feeding to the facing-cancelling machine. On this machine is also a buffer stacker to absorb irregularities in flow, and this buffer is coupled back to control the culling belt. The facer canceller is the only imported machine in the whole installation. It was made in the U.S.A. by Pitney Bowes, to meet the requirements of the Australian Post Office. The machine functions are mechanically similar to facer cancellers made by Pitney Bowes in other countries, but the stamp sensing electronics are designed for a short delay tagging phosphor, emitting in the orange/red range. The phosphor has been incorporated in either the paper or the ink for different stamps, and is activated by black U.V. light.

In any bundle of unfaced letters, stamps correctly positioned on envelopes can appear in any of four positions, upper front right, upper rear left, lower front left, and lower rear right, it can be seen that the last two are letters upside down in the bundle. The machine consists of two almost identical units, connected by a turnover belt. The first unit senses, cancels and gates all stamps on the lower edge, using the top of the letter as a reference, and turns the remainder over to present them to the second unit with their stamps now on the lower edge. Those with no stamps, or more stamps than can be cancelled by the machine die, are rejected.

Reference to Fig. 4 will show the culling, edging facing units in the top centre of the diagram. Each machine is rated at up to 30,000 letters per hour, and as the rated work load of a coding suite is around 60,000 per hour, two culler, edger facer canceller units are allocated to feed one suite, making a total of four for two suites. The faced and cancelled letters are placed on a storage and stream feed console for despatch to the coding suite. Conveyors are provided adjacent to each culler to deliver culled out newspapers and packets and oversize letters to their respective processing areas.

The Bundle and Bulk Machines

Mail coming from two other sources has to be fed to the coding suites, namely from ex-mails which is faced, cancelled and bundled, or in small letter bags, and from bulk users which is faced and prepaid, or is cancelled in the bulk area prior to feeding to the bulk dispatching machine.

Looking at the bundles machine first, the bundles of letters come from mail opening by conveyor and storage to the feed belt of the machine. Operators pick out bundles for direct despatch and drop them down hatches in the machine, and cut bundles for primary sorting, extracting oversize letters. Provision is made to "hold back" certain categories of mail if required, i.e., if suburban mail is being processed to meet a despatch, country mail can be "held back" by placing the bundle on a conveyor on the machine. Later this mail is returned to the feed belt for bundle cutting. Each operator has access to a stream feed dispatch unit, which supplies the two stream feeds to two coding suites (See Fig. 4). The bulk machine supplies one suite of coders, and is similar to the bundles machine, except that "hold back" and direct bundle despatching facilities are not provided.

The Stream Feed Despatch

Each coding suite is supplied with letters from a stream feed system, which originates in the canceller, bundles, and bulk areas as described above. Each stream feed, so called because the letters "stream" at high speed held overlapped between two small belts, is fed from despatch units on the despatch console in the case of the facer cancellers, or the bundles or bulk machines. The despatch console consists of a storage belt, and up to three despatch units, which may be used as required. The bundles machines contain six despatch units, and the bulk machine three. The letters are placed in the manned despatch units on each machine, and the stacker feeder units at staffed positions on each suite "call" for letters from their respective despatch units as they are required, and the unit automatically runs. When the calling stacker feeder is filled, the next empty one in the queue is connected to the main stream feed line by its diverter, and it receives mail. As mentioned earlier the stream feed operates at high speed, and each has to be capable of supplying letters at up to 1000 per minute to its coding suite.

The Coding Operation

The coding suites of 30 positions at Redfern are made up of 15, two operator units, each of which is a complete self-contained machine, and forms the building block on which a system can be designed (See Fig. 5). The two operator unit was chosen for a number of reasons, the main ones being:—

(i) The two unit frame is the maximum convenient size for handling and installation.

(ii) The two unit machine allows maintenance access to the unit and cleaning channels.

(iii) The 30 channel diverter is shared between two operators.

Although grouped in pairs, each operator is provided with a completely individual coding position, including

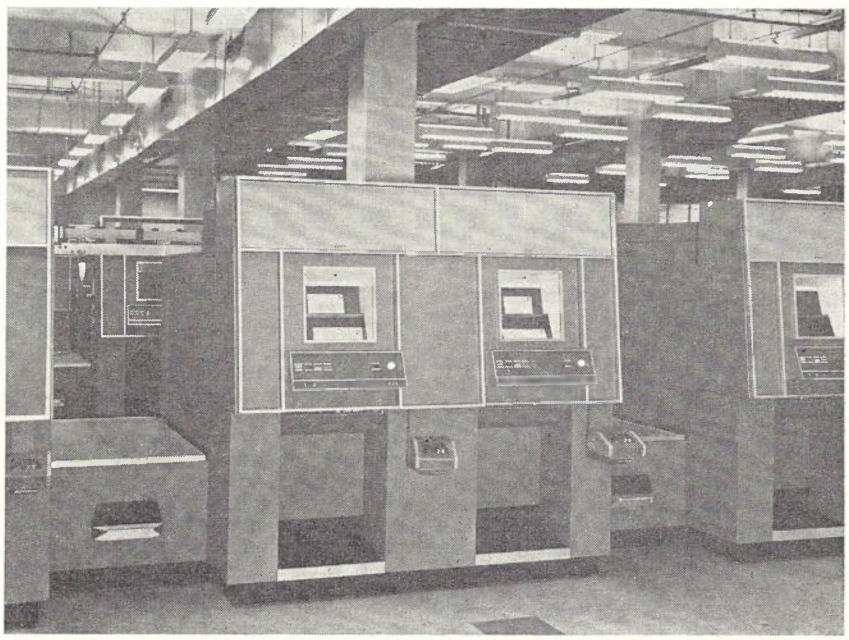

Fig. 5 — Two Coding Positions.

TABLE 2

Button	Function	Indication
Call	To call Overseer or Technician	Lights amber until call acknowledged
Stop	Switches off operating power to coding position	Lights red
Tape Short	Indicates supply low	Lights amber
Tape Empty	Indicates tape supply empty	Lights amber
Heater on	Switches on heater	Lights green
Heated	Indicates that printing head is ready for use	Lights green
F.S. Full R.S. Full	Indicates if letters are in front or rear stackers of stacker feeder	Lights green when front stacker full of letters Lights green when rear stacker full of letters
Start	Normally operated by overseer 10 minutes before staffing machine to power machine and heat printing head	Lights green when machine on
Isolate	Allows operator to clear stackers Inhibits stream feed to that position. Operated by Pushing F.S. — R.S. Full Button	Lights amber when isolated

ters in accordance with the code marks in the envelope. Similar to the coder a raised walkway is provided around the machine to allow ready observation of and access to the reading heads, and the electronic cards are mounted in racks under this walkway. Each decoder is a complete unit in itself, needing no recourse to the central coder memory.

Twenty decoders have been provided at Redfern, 8 for suburban, and 12 for the country secondary sorting process. With this arrangement the suburban secondary and large country centre sort can be completed in one pass, (see previous paragraph "Code Marking the Letters"), and the intrastate country in two passes.

Each decoder terminates one of the primary and transfer channels from the coders, and gives a separation of 30 (29 + reject) on the first pass. The transfer channel first enters a separator unit which also incorporates an overflow stacker, and then feeds to stacker feeders which are incorporated in the decoder reading heads.

The reading head comprises this stacker feeder, almost identical with that on the coder, a vacuum pick off, a brush type letter edger to ensure that the letter rides down on its lower edge, an ultra violet light source and photo multiplier reader, a binary diverter, and a 30 channel diverter. The photo multiplier reader is able to be raised or lowered to read the required code row (C1, C2 or C3) for the pass being run through. An indicator shows the row number being read at any time, and allows the operator clearing the final stackers to identify the destinations.

To handle the letter loads for the suburban and country sections, the decoders are initially fitted with three reading heads plus one spare position for the suburban, and two heads plus one spare position for the country. At the maximum rated reading speed of 7000 per hour per head, this gives a handling capacity of at least 20,000 per hour for each suburban decoder, or 14,000 for the country.

Because each decoder is almost identical apart from the number of heads, and is completely self contained, country or suburban mail can be handled on either machine, providing full flexibility in case of machine breakdown on unusually disproportionate loading.

The Aggregating Channels and Letter Transfer

Each coder suite has thirty $1\frac{1}{4}$ inch wide clearing channels passing right through, and terminating in a wedge shaped tail unit. Letters are dropped into the required clearing channels by the 30 channel diverters in each two operator unit, and travel upright on their longest edge to the tail unit. One channel (No. 30) terminates in a reject stacker, but the remainder feed into chutes fanning out from the side of the wedge shape, which convey the letters on to aggregating channels, at the same time laying the letters over into a flat position in preparation for this.

Reference to Fig. 4 shows the wedge shaped tails from the five suites over the aggregating channels, which as their name implies, collect or aggregate the output of each clearing channel from a suite to a single cross channel in preparation for transfer to the next operation. The aggregating channels belts are not horizontal, but slope at $37\frac{1}{2}$ degrees, to cause a letter fed from a chute to position itself on the belt. Obviously, with the completely random output from each suite, letters from one suite could quite easily be deposited by the chute on the output from another suite. The $5\frac{1}{2}$ in. wide belt, travelling at around 300 feet per minute has been designed to cope with this situation. To conveniently drive the aggregating belts, each adjacent belt runs in opposing directions, as shown on the figure. At each end of the horizontal run, the letters move in between two belts, which carry them down and around to the decoders or stackers on the floor below. This equipment called the letter transfer system, is similar in operation to the stream feed described earlier. At the decoders, as mentioned earlier, the transfer channels terminate in separator units, which even out the more or less random load, for presentation to the decoder stacker feeders. In the interstate, overseas and city despatch areas, the transfer channels feed into large capacity stackers, capable of storing approximately 4000 letters without attention.

Should a fault occur anywhere along a transfer or aggregating or coder clearing channel, it is imperative that no more letters be sorted into that channel, and automatic inhibit circuitry is brought into action which directs all 30 channel diverters to feed letters destined to the offending channel, to "reject". The coder operator is unaware of this happening, and is not required to take any particular action should a fault occur in the channels, thus avoiding any upset to the sorting rhythm.

The automatic collection of the output of the coding suites, and the transfer by conveyor to the secondary sorting process is a feature of the Australian system, particularly when peak hour loads of 300,000 per hour are considered.

The Statistical Console and Alarm System

To enable an assessment to be made of the letter load at any time, and provide a centre to take action on calls from the coding suites for supervisory or maintenance staff, a centralised console has been provided. Any "call" button pressed from the coding machines is indicated on this console for identification, and an indication is also given whether the positions are loaded with letters ready for sorting.

Allied with the console is a comprehensive alarm display panel located in the maintenance room on the fourth floor, covering the whole letter equipment in that floor, with repeats of the decoding alarm lamps from the third model must demonstrate that it could work at that speed.

Once the functional principles of each assembly in the machine had been established, the engineers concerned were required to use all their skill and experience to design a machine from "coathanger made" models. The object at this stage was to design the sub-assemblies for production with all the functional features, materials and size, and bearing in mind the possible production techniques to be used in manufacture. From this point on it could have been said that the project was just a matter of straightforward machine design. Needless to say, "straightforward machine design" proved to be about as straight as a "Big Dip" railway and just as taxing to the designers.

These units were then life tested. The previously proven one-function-per-second demonstrated its workability, but did not test the reliability. The statistical information obtained from these life tests then determined the range of tolerances over which the ultimate sub-assembly must operate for a given reliability.

After the tests of individual units were completed, the next step required was to connect them together and make them work in correct sequence. When satisfactory results were obtained, the necessary modifications were recorded on the drawings and these were issued for production of a prototype. Without any doubt, construction of a prototype is necessary, since it not only demonstrates the workability, but also the feasibility of production. Considerable production concessions were given on many occasions, before both Engineering and Production Divisions were satisfied with the end result.

The System, Its Machines and Sub-Assemblies

To recapitulate on earlier descriptions it is proposed to trace again the path of incoming letters through the system. As seen on the schematic diagram (see Fig. 4) each suite is equipped with its own supply units. Suites Nos. 4 and 5 are served by 2 Storage and Despatch Consoles each having 3 Stream Feed Despatch Units. The output of 2 Special Facer-cancellors is fed into each S.D. Console. Suite No. 3 is supplied by Bulk Table (bulk mail) which has 4 Stream Feed Despatch Units, and suites Nos. 2 and 1 are fed by a Bundle Sorting Machine from 6 Despatch Units. Each Facer-cancellor is supplied by pillar mail, which is fed through a Culling and Edging Machine. In this machine all newspapers and small parcels are extracted, leaving only the letters. Connected in tandem to this unit is the Gauging Machine which rejects all letters outside the acceptable size, thickness, or stiffness by means of P.E. Cells and microswitches. Oversize letters terminate in a stacker which forms a part of this machine, and they are then sorted manually.

As the titles indicate, the Bulk Table handles bulk mail and the Bundle Machine all bundled mail from suburban, interstate and overseas centres.

In order to meet the requirements, specially designed Despatch Units are used by the combination of a perforated belt and vacuum with a separator, and it is possible to effect the despatch of letters separated, but in an overlapped condition, which means that leading edges of letters are approximately 2½ in. apart. By using this approach, it is possible to reduce the effective length of each letter to practically 2½ in. intead of the average 8 in., and this in turn considerably shortens the despatch time.

The outgoing letter stream is fed into a primary letter transfer which consists of two parallel belts in a vertical plane travelling at approximately 600 ft/min. This feeds to an Entry Transfer and Deflector, which has 30 gates for directing each stream of letters to one of the 30 vacant Stacker Feeders in the suite.

The Stacker Feeder Primary (See Fig. 8)

As the title indicates, the primary functions of this unit are:

(i) Receive and stack incoming letters.

(ii) Transfer and feed of Stack to Vacuum Pick Off.

The maximum holding capacity for each stack of letters is 18 in., which represents approximately 300 letters of average size. This is also the capacity of each Stream Feed Despatch Unit.

Letters entering the Stacker Feeder stack up with their leading edges against the left hand wall of the tray, right way up, and facing the front.

The three lobed Starwheel rotating clockwise at 1300 r.p.m. "beats" the letters towards the front of the machine and the stack builds up between the Front and Rear Stacker Arms, the latter remaining stationary for the time being and the former being moved slowly forward by the letters as it keeps the stack upright.

To assist incoming letters to enter the rear of the stack, there is an Edging Belt, which is inclined 10° to the longitudinal centre line of the machine. The purpose of this belt is to move the right hand (trailing) sides of the letters forward to form a wedge shaped space into which the newly arriving letters flow. This belt is arranged with its rear surface above the tray and its front surface below it; thus making its effect on the letters strong at first, but gradually weaker, until it does not move those which are nearer the front.

Assisting the stack to move forward is an Inching Belt, which is parallel to the centre line of the machine. This belt is arranged with the rear surface below the tray and its front surface above it, thus making its effect on the letters greater as they move forward.

When the last letter of each stream enters the Stacker Feeder (this is detected by Deflector PE cell) the Diverter is de-energised and the Starwheel and Entry Transfer, Inching Belt, and Edging Belt all stop.

The Letter Control Bridge Assembly, at the front of the machine, is equipped with a Feeder Arm and a Last Letter Control; which are connected to microswitches. When the last letter of the previous stack has passed through the last letter control, the microswitches bring in the solenoid operated clutch, driving the rear Stacker Arm which moves forward, carrying with it the complete stack and the Front Stacker Arm.

This also causes the Feeder Arm to be driven (upright) from the front to the rear of the machine. When the Rear Stacker Arm completes its movement, the Feeder Arm drops behind it. Both arms are then driven forward till the Rear Stacker Arm springs upward, which causes the Feeder Arm to take over the forward movement of the Stack to the Vacuum Pick Off. Assisting the Feeder Arm to move the stack forward, are three Feeding Belts. Lights on the operator's control panel then indicate that letters are in position for the operator to commence sorting.

When the front Stacker Arm reaches the Bridge it springs upright, which causes the drive sliding lock to change over, whereupon it is driven to the rear, together with the Rear Stacking Arm in upright position. By arrangement of helical track, both arms are lowered when reaching the Starwheel, ready for the next stacking cycle.

The movement of the three Arms is arranged by sliding locks, which are changed over by stop brackets, follower wheels and over-centre (snap-action) springs. These sliding locks are engaged by Roller Links on their drive chains in such a manner as to drive the Arms to the rear or to the front as determined by the locks being up or down respectively. The two stacker Arms' drive chain is on the left of the machine, and the Feeder Arm's on the right. These two chains are driven by Indexing clutches from a common layshaft, revolving at 28 r.p.m. and driven via a slipping clutch by a 0.21 H.P. motor.

The Vacuum Pick-Off and Separator Rejector

The purpose of these two separate but closely-related pieces of equipment is to ensure that only one letter at a time is allowed to drop into the Presentation Unit. This sounds like a simple requirement but the implications and problems associated were not small by any means.

Separation is achieved by two differing applications of vacuum, the stronger from the vacuum Pick-Off, and the weaker from the vacuum Rejector. Additional assistance in separation is achieved by the application of a "slip/stick" principle, which is letter in the first view position while coding the letter in the second position.

The one handed keyboard is mounted on an adjustable stand on the right hand side of the operator, allowing positional adjustment and locking.

On the lower part of the Presentation Unit is the Operator's Control Panel (see Fig. 6). As described earlier this consists of "stop" and "start" switches, a maintenance "call" button, rear and front Stacker "full" indicating lamps, "heater on" and "heated" lamps, Tape "short" and "empty" indicators, and also an "isolate" switch. With this the Operator can isolate his position from further intake of letters. The "heated" lamp will come on when the punches in the Printing Head are heated to the correct operating temperature.

Movement of letters through this unit is achieved mainly by gravity and the dropping of letters from one position to the next is controlled by flaps which are operated by rotary solenoids. An edging belt in the second view position ensures that all letters are aligned from their trailing edges before dropping to the printing (coding) station, where they are held by the Printing Clamp in position for the duration of the printing operation. Code marks are printed on the rear face of letters by transferring the wax based phosphor filled coating of a thin nylon film (approximately 0.0007 in. thick) under impact, pressure and heat from printing plungers of the Printing Head. Almost complete transfer of coating from this film is achieved in approximately 100 milliseconds. The Printing Head contains a matrix of 31 springloaded plungers which are held in "ready" position by the spindles of linear "Selector" solenoids, which when energised acts as a trigger, thus allowing any number of preselected plungers to print a mark on the letter by a simultaneous pulse to those solenoids. The plungers are reset by an air cylinder mounted on the back of the printer block. Thirty print plungers are used to provide the necessary selection of code marks, while the remaining plunger carries the identification number identical with the number of the corresponding coding position, and provides a means of tracing faults.

In order to conserve marking tape, as mentioned earlier, the print plungers are positioned in a staggered manner, so that one punch is never positioned with another above or below it. This allows the tape to be indexed a distance equal to the height of the code mark only. (See Fig. 2.)

The printing portion of the print plunger is made from high heat conducting material and is mounted in the heating chamber. Hot air is supplied by an element mounted in a tube into which a stream of air is injected. The temperature of the air is controlled by a thermistor in the heating chamber and a diode. A thermostat is also provided on the heating element to cut off the power supply should there be a failure of the air supply.

The marking tape which passes in front of the plungers is indexed by a rotary solenoid drive from a slip clutch equipped Supply Reel. The expended tape is wound on to a Take Up reel which is continuously driven through a preset slip clutch. Provision in the tape supply system warns the operator ("tape short light") when tape supply has diminished to a preset level of a swinging arm mounted microswitch. A second "Tape Empty" device renders the operators keyboard inoperative, making it impossible to feed uncoded letters into the system. This is achieved by a strip of conductive material fixed on the end of the tape. When this strip passes over a segment pin, which normally acts as a tape guide, a circuit is closed and the above condition arises.

When the printing operation is completed, the Print Clamp is released, the solenoid on Print Drop is actuated, and the letter drops on the presentation conveyor which moves it horizontally to the:

Diverter Entry Flap: This two compartment unit handles all letters from both operators (left and right). The Solenoid operated flap on each component then allows the letter to drop into the:

30 Channel Diverter: As the title implies, its main function is to divert letters to 30 independent channels (destinations) in $1\frac{1}{2}$ in. pitch. The letter, as it drops from the Diverter Entry Flap, is gravity fed into the unit, and transported through between 4 flexible perforated belts, and the top of the stainless steel diverting flaps. Diversion of letters to the selected channel is performed by a rotary solenoid actuated roller which is resting on top of the belt directly above each channel. When the solenoid in the Actuator is energised, a downward force of the roller deflects the 4 perforated belts so that the letter is guided into a chute. The corresponding diverting flap becomes momentarily free to move down as the letter enters. In the absence of any impulse to the rotary solenoids, the mechanism of each actuator locks the corresponding flap, which then acts as a support platform, thus allowing letters to slide over freely. The diverting rollers are free wheeling (idling), providing just sufficient pressure for the belts to transfer the letters.

If, at any stage, blockage of the unit occurs, the unit and the mail in it is protected by an adjustable slip clutch on the motor, and a pair of P.E. cells which immediately stops the unit. Removal of letters from within the unit can be made with ease by opening the top half of the Diverter, since the two halves are connected by a hinge arrangement. This unit, the same as all other assemblies, is a self contained plug in type for easy removal, and is mounted directly above:

The 30 Channel Conveyor: This unit handles the output of all Coder Machines in a suite. Twenty-nine channels at $1\frac{1}{2}$ in. pitch (same as the 30 Channel Diverter) are conveying coded and sorted letters into the system while the 30th Channel handles all rejected letters. All letters with illegible addresses, torn, etc., should be diverted by the operator to this channel, which is equipped with a Termination Stacker on the end of each suite.

With the help of a fibreglass chute, letters from each channel are transferred on to one of 29 Integrating Channels which carries the output of the identical channel from each suite. Each of these channels carries a 37° sloping belt $5\frac{1}{2}$ in. wide with independent drive, as described earlier.

A twin belt system is used on the end of each channel to transport the letters through Descending Units to various floors, and through a secondary letter Transfer to individual destinations.

The secondary transfer is identical with the primary transfer, but the speed is reduced. On the end of each line is an accelerator which increases the entry speed of letters into the Separator to 450 ft/min. This increase in speed serves to a certain degree as a separating means. Because letters are arriving at this point in random quantities i.e., single, overlapped, or in batches, the:

Separator: Plays an important part in this automatic system. To achieve automatic feeding and diversion of letters to multiple head Decoder units, the main function of the Separator is to receive all random incoming letters in a buffer store, and feed them to an Entry Transfer in single file with approximately 3 in. gap between the leading and trailing edge of each letter. Separation in this instance is achieved by use of a rubber reverse roller and acceleration to approximately 600 ft/min. Secondary functions of this unit are:—

(i) automatic diversion and stacking of incoming letters into inbuilt Stacker.
(ii) hand feeding of letter stack for tertiary sorting to Reading Heads.

The abovementioned functions provide the required flexibility of the system. Letters from the Separator are then fed to the Entry Transfer Deflector Secondary in the abovementioned manner. (See Fig. 9.)

Part of this unit is the diverter Flap (gate), which diverts letters automatically through the Deflector into the Stacker Feeder Secondary as required by the Stacker Feeder i.e., when the first Stacker Feeder is full, the diverter Flap closes and the letters are fed to the second Stacker Feeder and vice versa. Operation of the Secondary Stacker Feeder is identical with the Primary. When letters are transferred to the front of this unit, a **Vacuum Pick-Off and Reader** commences operation. This unit consists of Vacuum Pick-Off and Separator,

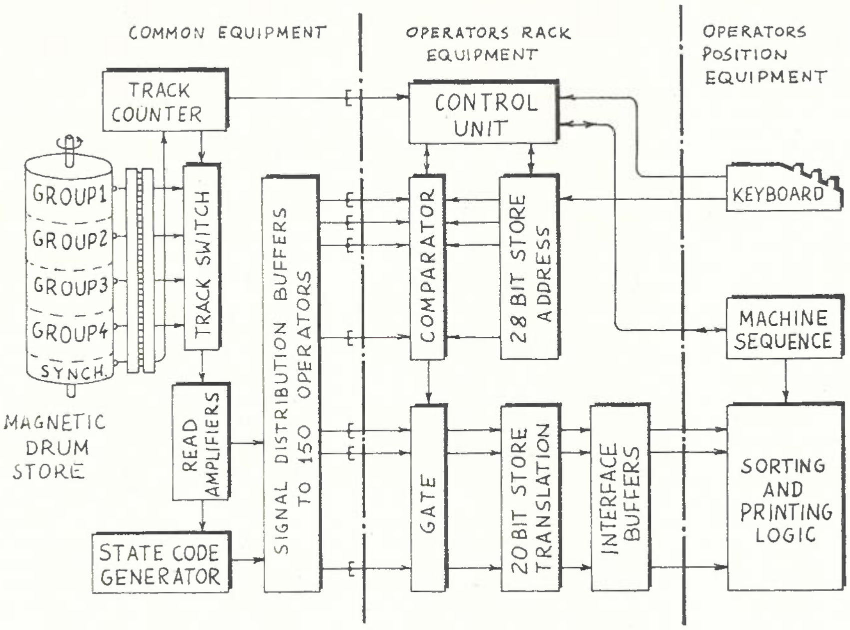

Fig. 10. — The Register Translator.

need to be solved in any new machine. These sort of problems can and will be solved by the continued vigilance and analysis of the responsible design engineers. Many of these problems are identified during the testing and commissioning periods, but management is called upon to decide that the "time is up" and the system should go into operational trials, where the real effect of such identified problems can be seen and properly recorded statistical performance data can be obtained.

THE TRANSLATOR EQUIPMENT

General

In this section of the paper the operation of the Register Translator equipment, the magnetic drum memory, and further details of the coding keyboard will be given.

The main function of the Register Translator is to accept and store an address or a place name in a suitably abbreviated form, and to find from this a translation, comprising a set of four route numbers, which arbitrarily defines the sorting route, letters for this destination should follow. Both in its circuits, and as a system, the Translator can best be described as a real time special purpose computer. (See Fig. 10.) It has all the elements usually associated with computers, although it lacks some of the refinements of general purpose machines. The input equipment is a manually operated keyboard. An address register is used to accumulate keyed in information, and this is compared with information in the Main Memory; the magnetic drum comparison is the only arithmetic function carried out by this machine. The Main Memory has access via a translation gate to a second accumulator, the Translation Register, and from here it connects via an interface Buffer to the output equipment, which is made up of the Printer and other equipment in the Sorting Machine. The order of operations is governed by a control unit which has direct or indirect access to all the above sections.

The Magnetic Drum

The permanent memory of the translator is a magnetic drum, the surface of which is a continuous layer of ferric oxide. Information on the drum is stored on 200 tracks, each of which stores 4,000 consecutive bits. Each track is provided with a read head and the tracks are defined by the area scanned by each head as the drum rotates. The information stored on each track appears as a 100 Kc/s alternating voltage signal across the terminals of the read head associated with the track.

This alternating voltage signal is phase modulated and each 10 microsecond cycle represents one bit. The value of a cycle, one or zero, is determined by comparing the phase of the cycle with a reference signal which is obtained from a special track called the synchronise track. If the cycle represents a zero, it is in phase with the reference signal. If it represents a one, it is 180° out of phase with the reference.

The read signals have an amplitude at the read head terminals of approximately one millivolt. The signals are amplified and detected by a synchronous detector which produces an output in the form of a standard logic level. The information on each of the 200 tracks is synchronised at the time of recording with the reference track, therefore all tracks are synchronised with one another.

The addresses and translations are recorded on the drum in a series of vertical "time-slots" covering several tracks. One bit of information is stored on each track and the drum reading heads are arranged in such a way that all the bits of information for one address or translation are read out in parallel at the same time.

Information on the drum is separated into four groups of 45 tracks. Each group has 25 tracks allocated to addresses and 20 tracks are connected sequentially to 45 read amplifiers via read switches, that is, each

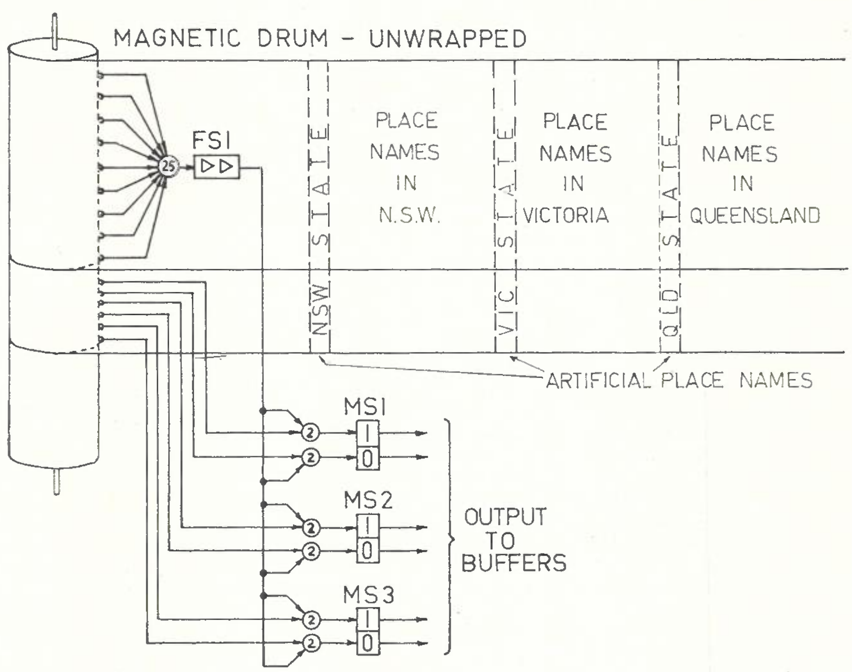

Fig. 11 — The State Code Generator.

previous address is still held in the address store and it will not be cleared until a translation is produced or a reject command is given by the operator.

When the reject command is given, using a special key on the keyboard, the address store is cleared and the letter is sorted into the reject channel. If the operator considers that the wrong information may have been keyed, the "cancel" key may be pressed. Operation of the "cancel" key clears the address store, but the letter is held in the viewing window and the operator can attempt to key the address a second time.

The operator cannot get out of step with the translator, therefore, because if too few characters or too many of the addresses are keyed, the letter will not move from the viewing window. It has already been stated that the probability of a random combination of letters producing a valid address code is quite remote.

Routiner

The Address Stores, Comparators and Translator Stores for 150 operators are mounted on 5 racks of equipment. A sixth rack is used for mounting common equipment.

The organisation of the translation operation is basically simple and only three sections of the common equipment are essential to maintain the service required for letter sorting. These sections are —

(i) The Magnetic Drum, for which a fully programmed standby is provided.

(ii) The Strobe Pulse Generator which is the basic timing circuit synchronising all operations.

(iii) The Read Amplifiers and Signal Distribution Buffers.

All other sections of the common equipment are used only during programming and they will be required for not more than one or two hours per month once the initial programming of the drum is completed.

Letter sorting will normally be carried out for about 22 hours each day in the Sydney Mail Exchange although it will not be necessary to staff the total available operating positions for this time. The actual number of positions staffed is a function of the traffic flow in the Mail Exchange determined by the Operating Authority. The common equipment however, will be required to function almost continuously and faults must be located and rectified within a few minutes to maintain the necessary grade of service.

In the Strobe Pulse Generator, certain circuits are provided in triplicate and connected in such a way that any two will carry the load if the third one fails. To permit quick replacement of the faulty equipment, an indication is given at the control console which identifies the particular plug-in unit which has failed.

The performance of the 1,400 buffer amplifiers, 180 track switches and 45 read amplifiers is monitored by a unit called the Routiner. Fig. 12 is a simplified logic diagram of the Routiner which also illustrates the design techniques used in the Translator.

The Buffer amplifiers are mounted in 70 identical plug-in units, each with 20 amplifiers. The plug-in units are in ten rows with seven units in each row. If a fault occurs in a unit, it is identified by two sets of lamps at the control unit. One set of lamps indicates the row and the other identifies the unit of the seven in the row which is faulty. Read amplifiers and track switches produce similar lamp indications which quickly identify a unit which is to be replaced.

The routiner responds to intermittent faults and once an indication has been given, the lamps will remain alight until the monitoring circuits are manually reset. There is an additional indicator which shows whether the fault is constant or intermittent. If it is intermittent, an indication of the rate at which the fault is occurring is given.

The routiner generates seven consecutive timing pulses designated T1 to T7 once during each revolution of the drum and in synchronism with the drum. In each of the plug-in units, the outputs from all the buffer amplifiers in the first unit are gated with T1, similarly outputs from units 2 to 7 are gated with pulses T2 to T7.

During each of the timing pulses, the coincident information read from the drum is arranged so that all the buffers which are gated with the pulse are in the '1' state and have just switched to that state from 'O'. The output from each gate, therefore, is a '1' during its timing pulse.

The seven gates are mounted with the buffers they are monitoring and their outputs drive an inverter through an OR gate. There is one of the inverters, VR1 to VR10 associated with each of the ten rows. If the system is functioning correctly, the outputs from all the inverters are 'O' during the total period of the timing pulses T1 to T7.

Each VR output is gated with a signal VR1 at the input to an MR flip-flop. The FR1 signal is only in the '1' state during the period T1 to T7. The outputs from these gates, therefore, are always 'O' if all the buffers are functioning correctly. When a fault occurs, one of the VR signals will be '1' during the period T1 to T7 and one of the flip-flops MR1 to MR10 will set to give an indication of the row in which the fault occurred. A lamp associated with each flip-flop gives a visual indication.

The faulty unit in the row is detected by gating signals VR1 to VR10 with FR1 via an OR gate which drives buffer FR2. This buffer is normally in the 'O' state and it switches to the '1' state only during the period of the timing pulse of a faulty frame.

The output of FR2 drives seven gates. Timing pulses T1 to T7 provide in the second input for each of these gates at the inputs to flip-flops MR11 to MR17. The actual timing pulse during which a fault is detected sets one of the flip-flops which gives a lamp indication to identify the faulty unit.

An alarm flip-flop MR18 is provided which will set to any fault and operate an alarm relay. Once an alarm is given, FR1 inhibits the gates at the inputs of all flip-flops in the routiner to prevent a multiple display which could be ambiguous if more than one fault occurs. A key resets all flip-flops.

```
WRITE MARKER                :
WRITE ADDRESS               ,
WRITE TRANSLATION           =
CHECK MARKER                .
STATE CODE                  /

TYPICAL PROGRAMME

:13400/1
BONDI=03 05 30 30, GLEBE=04 12 30 30,
ALXIA=03 29 30 30, REFRN=28 11 30 30,
MACOT=26 07 30 30, PADON=27 26 30 30,
RADCK=26 11 30 30, COGEE=04 09 30 30,
0--33=06 12 30 30, 0--34=04 09 30 30,
0--35=26 17 30 30, 0--36=26 19 30 30,
AAAAA=18 30 30 30, BBBBB=19 30 30 30,
                                 13414
```

Fig. 13 — Data Input Code.

THE TRANSLATOR HARDWARE

The following basic circuits are used in the Register Translator:—

(1) The Diode AND gate
(2) The Diode OR gate
(3) The Logic Inverter
(4) The Flip-Flop

The strobed flip-flop is used in the common control equipment and in the comparators when synchronisation with the drum is essential. A less expensive unstrobed flip-flop is used in the address and translation registers. This circuit was specially developed using two cross coupled inverters, using feed back through an AND/OR gate. The circuit is shown in Fig. 15. The upper gate of the unstrobed flip-flop is the SET input which is normally in the zero state. The external input of the lower AND gate is the RESET input which is normally in the '1' state.

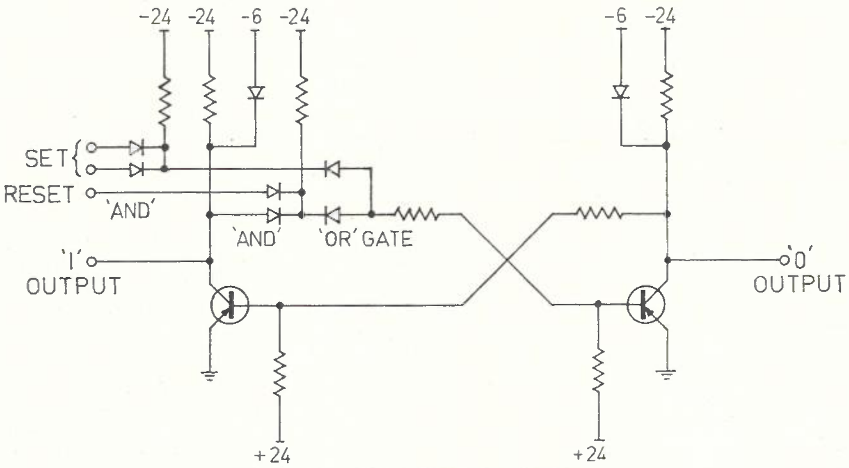

Fig. 15 — The Unstrobed Flip Flop.

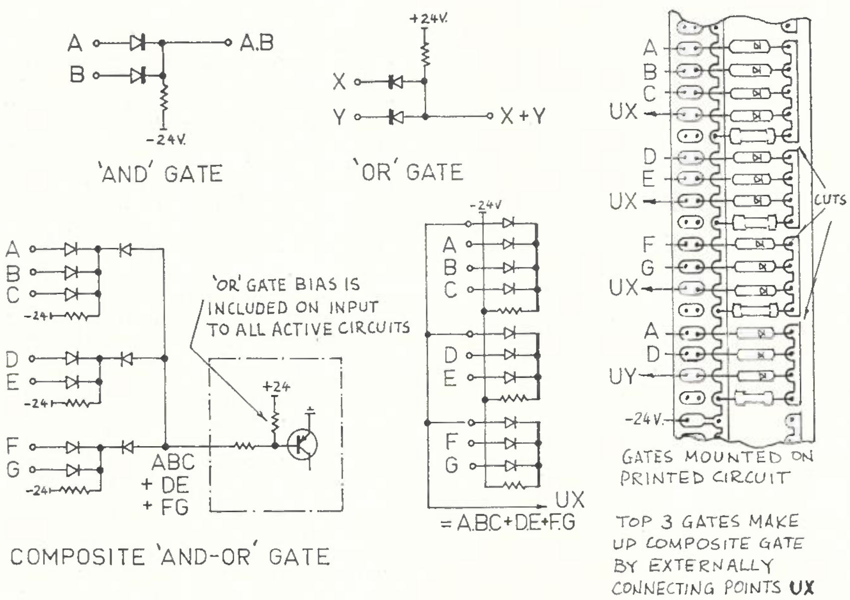

Fig.16 — Diode Gates.

UX	=	A . B . C	COUNTER ON 10
"	=	D . E	COUNTER ON 11, 12
"	=	F . G	COUNTER ON 13, 14
UY	=	A . D	COUNTER ON 6, 7
"	=	E . VZ	SET ON COUNT 1
UZ	=	VX . VY . G	RESET ON COUNT 21

Fig. 17 — System Logic.

The power buffer is also used frequently in the common equipment. This circuit consists of two inverting stages connected in cascade so that the output has the same logical significance as the input. The component values are so chosen that the maximum current amplification is achieved. This is usually expressed in terms of fan out, that is, the number of gates that a unit can drive when it is driven by one gate. The fan out is 20 for the power buffer, and 5 for the inverters and flip-flops. As well as the circuits listed there are a number of special circuits associated with the drum and the strobe pulse distribution system.

The logic levels used in this system are — 6 Volts representing binary one and 0 Volts representing binary zero.

The active circuit elements are mounted on printed circuit cards. The diode gates are mounted on a special printed card which is arranged so that various types of gates can be formed by cutting printed straps on the back of the card. (Fig. 16.)

Each AND gate is built up with an extra diode which is the output from the gate. This diode drives the following stage. If an OR gate is required several of these output diodes are wired together.

The printed circuit cards are hard wired into a plug-in frame which has cards mounted on both sides. All the cards are of the same height, but they vary in width in modular steps. From 6-10 cards may be mounted on the one plug-in frame. Two rows of test points are provided at the front of each frame and these are connected to various parts of the circuit so that they may be checked without removing the frame from the rack. The test points are connected to the inputs and outputs of all active elements in the frame and since all active elements are connected together via gates, the inputs and outputs of all gates are also available at the test points.

TRANSLATOR DOCUMENTATION

The manufacture of equipment of the type used in the translator involves the preparation of a large amount of detailed information and the documents used must be designed to promote the maximum accuracy and speed of preparation.

The preparation of documentation for the address stores, comparators and translation stores was relatively easy because each section is small and well defined. A block diagram type of document was used which was also useful as an explanatory drawing.

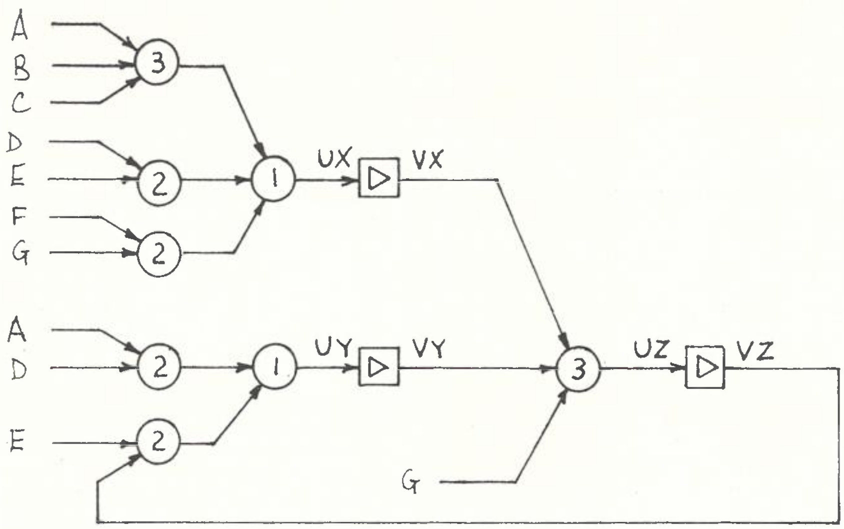

Fig. 20 — Block Diagram.

SIGNAL	CARD	TAG	PLUG POINT	TEST POINT	LOGIC CARDS 1				LOGIC CARDS 2		
UX		4		11	1	6	9				
VX	3	9	UA1	41						5	
UY		12		12				13	1		
VY		17	UA2	42						6	
UZ		4		13						7	
VZ	4	9	UA3	43					2		
A			UB1		2			14			
B			UB2		3						
C			UB3		4						
D	EXTERNAL		UB4			7		15			
E			UB5			8			3		
F			UB6				10				
G			UB7				11			8	

Fig. 21 — Logic Chart.

because each row represents tag points on different cards which have to be wired together.

Manufacturing information prepared in this way has proved to be very successful in practice. There are about 150 different types of frames used in the translator each with about 400 connections and the number of errors found so far is negligible.

CONCLUSION

The letter handling system described in this article is a major advance in mail handling technology even by world standards. The planning, design and development of the system presented a unique challenge to the Australian industry, both private and government; the successful completion of the project demonstrates how well this challenge has been met. Many factors contributed to the ultimate success but perhaps the most significant was the way the engineering staff of Telephone and Electrical Industries and the Australian Post Office worked as a team to solve the various problems which arose, particularly during the early stages of the planning and development of the system.

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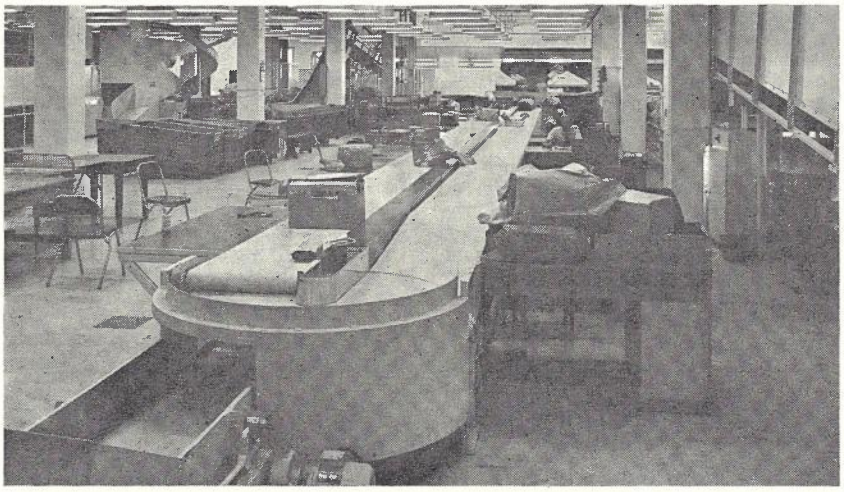

Fig. 2. — Customs Assessing Machine

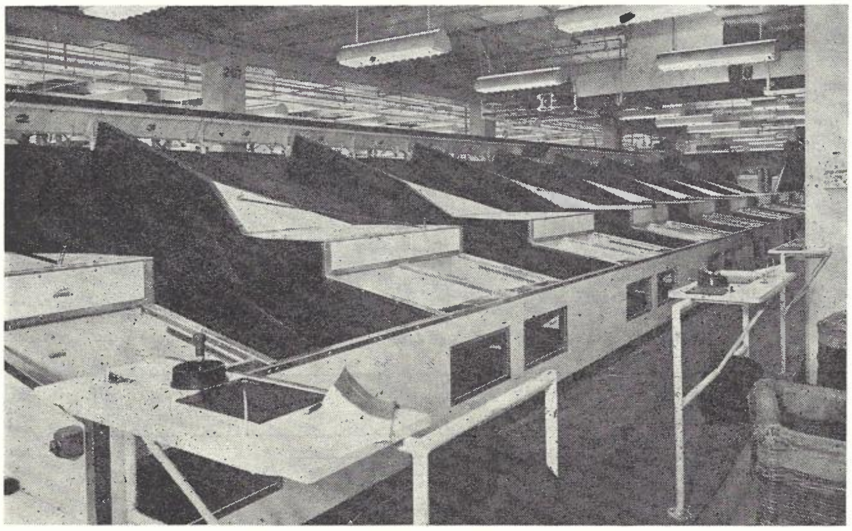

Fig. 3. — Parcel Opening Machine.

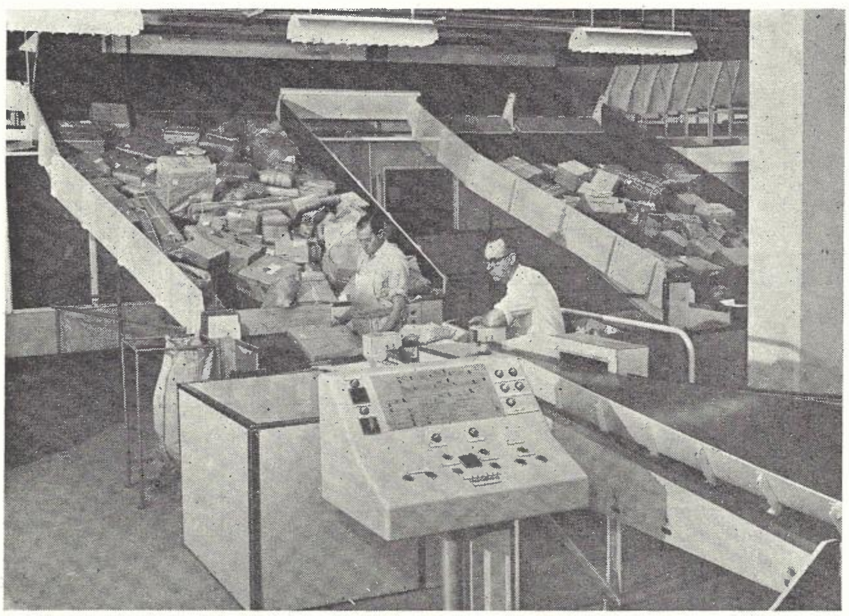

Fig. 4. — Primary Parcel Machine, Glacis and Sorting Positions.

Air and Customs mail goes to upper ground floor, via a spiral chute to await collection by the public. The Department advises the addressee that a parcel is awaiting collection.

THE PARCELS SYSTEM

Incoming bagged parcels are easily distinguished by a special shaped bag label at upper ground level, and are placed onto a parcels dock conveyor fed from a hatch above. This conveyor loads bags into a twin band conveyor, which elevates the bags to the 3rd floor where they are fed into one of two systems, ordinary parcels or Customs which has already been discussed. (See Fig. 1.)

Opening

Ordinary bagged parcels are fed on to a sloping belt, which distributes the bags to a number of glacis which load the parcel opening machine. Here at sixteen manual positions (see Fig. 3), the bags are opened and the contents are pushed onto the clearing belt under the parcel opening machine.

This conveyor can then feed parcels into either storage conveyors via a 3 ft. sloping belt, or by reversing belt direction of the clearing belt feed the faster and more direct rising conveyor, and then discharge onto a 3 ft sloping belt which loads the two primary parcels sorting glacis.

Storage

Parallel to and immediately behind the parcel opening machine, are found two storage conveyors which are loaded at their southern end. Photoelectric cells control the belt movement and result in maximum filling of the conveyor, which remains stationary until the light beam is interrupted by a parcel breaking the beam at a certain height above the belt. The belt then moves slowly until the light beam is again unbroken, and then stops.

When one storage conveyor is full a P.E. cell switches the input into the second storage, and then operators at the primary parcel sorting machine can automatically take parcels from the filled storage conveyor. The storage conveyors discharge seperately onto a conveyor at right angles, which loads a rising conveyor running north and south. This rising conveyor discharges onto a 3 ft sloping belt along the northern wall, which loads the two glacis on the primary parcel sorting machines.

In the foreground of Fig. 4 can be seen a control panel. The mail room overseer can have the parcels from the opening positions sent either to two storage conveyors and then to the sloping belt feeding the glacis, or choose to route the opened parcels directly to the parcel sorting machine, via the by-pass conveyor and finally onto the glacis.

This control panel is in the form of a mimic panel, and advises the operator of the condition of both storage conveyors whether $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ or full.

floor to an appropriate hole in the floor and discharges into one of twenty-one parcel hoppers located on the first floor.

These hoppers, which are used for overseas, interstate and suburban parcels, provide storage and permit access for final sorting into a bag hanging rack. When a bag is full it is tied off, sealed and made ready for despatch to the upper ground floor.

City parcels have a storage glacis on the first floor to receive city parcels for delivery by contractors. The parcels are discharged into the storage glacis from the city parcels chute, or the primary parcels sorting machine. From the glacis, parcels are manually sorted into chutes which distribute to parcel delivery contractor areas, on the upper ground floor dock area. (See Fig. 6.)

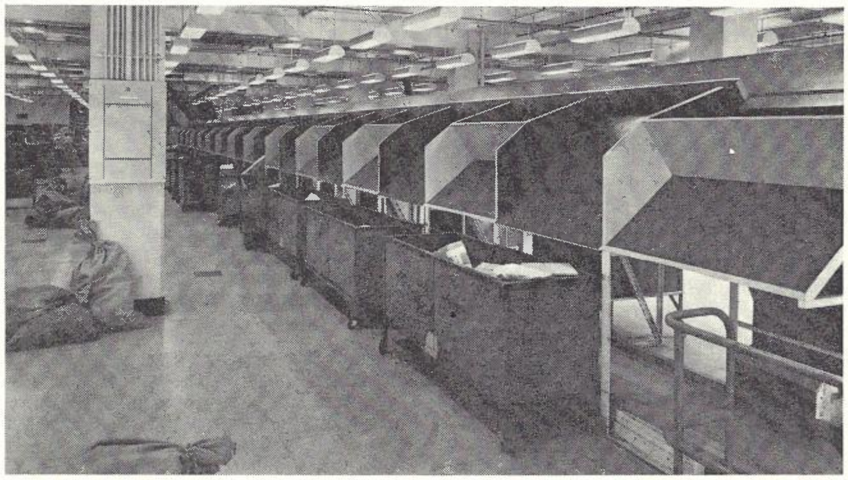

Fig. 7. — Country Parcel Secondary Sorting Machine Sloping Belt Section.

Country Parcels Secondary Sorting

One third of all the parcels handled are for delivery to country offices, representing the majority of the final despatches. In these circumstances, a secondary machine has been provided on the first floor, for the separation of parcels for conveyance to each final bag rack.

The primary parcel sorting machine provides for country parcels to be routed by it, via two drop panels feeding a floor conveyor which discharges into one of two storage conveyors, located overhead on the first floor. (See Fig. 6.) An advantage obtained by this arrangement is that the larger offices when making despatches to Redfern, can separately enclose parcels which are for country destinations.

Provision is made for manual tipping of this type of mail into the two country floor conveyors under the primary machine, and by this means the load on the primary machines particularly during peak periods is reduced. A light on the tipping chute indicates which conveyor to tip into depending upon which of the two storage conveyors are being loaded.

Should both country storage conveyors become full, the two drop panels from the primary machines will remain closed and a warning light becomes operative at the manual tipping positions. The country parcels now being sorted on the primary machine when both storage conveyors are full, will be discharged from the last drop panel which is always in the open position to collect, re-sort or reject mail.

The secondary sorting machine for country parcels is fed from the two overhead storage conveyors via a storage glacis on to the parcel sorting machine, similar to the primary machine. The secondary machine differs in contruction and operation, only in that parcels are diverted into bins situated on both sides of the sloping belt. This allows economical use of floor area to do final sorting into bag racks.

The construction of the sloping belt section of the machine, shows (see Fig. 7) how the drop panel feeds into wheeler bins and alternate panels use an upright wall to divert parcels underneath the sloping belt into a wheeler bin on the other side. Below this machine the bag despatch belt can be seen; this runs underneath the total length of the parcel machine and extends out beyond this to permit interstate as well as country bags to be despatched.

Final Sorting of Parcels

Suburban: In Fig. 8 the suburban hoppers located approximately in the middle of the first floor are shown. These hoppers are fed via a hole in the ceiling from the floor conveyors on the second floor, and when these hoppers are empty or only partially full portion of the vertical side wall can be swung across the floor of the hopper and provide a baffle which descending parcels must contact. This is to reduce possible damage to parcels when descending down the 30° slope, should a fragile parcel be struck by a heavy parcel in motion. This baffle is air operated and is in the non-operated position in Fig. 8 as there are a number of parcels in storage which will prevent any descending parcel from travelling very far.

The side panel on the working side of the storage hopper is lowered to

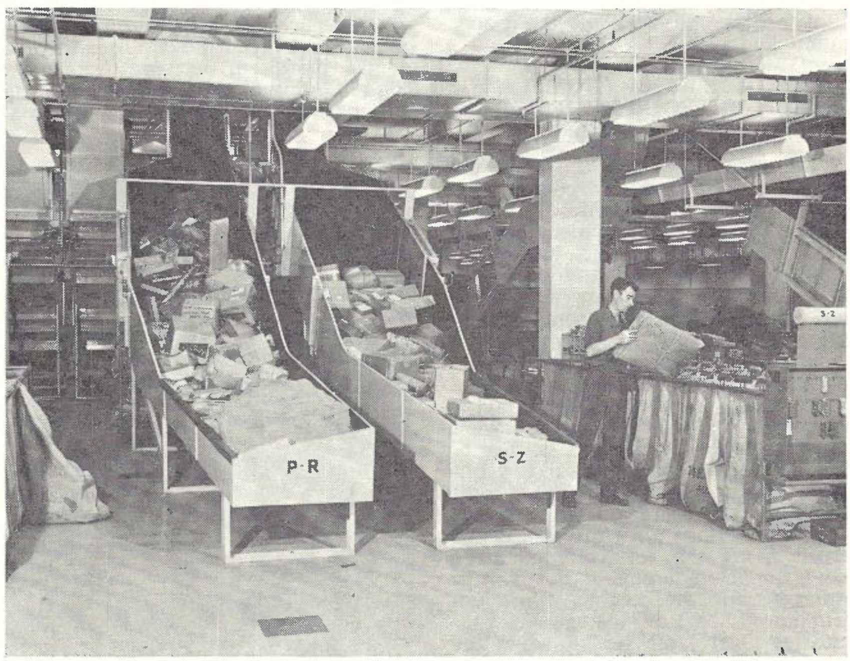

Fig. 8. — Parcel Storage Hoppers, Suburban.

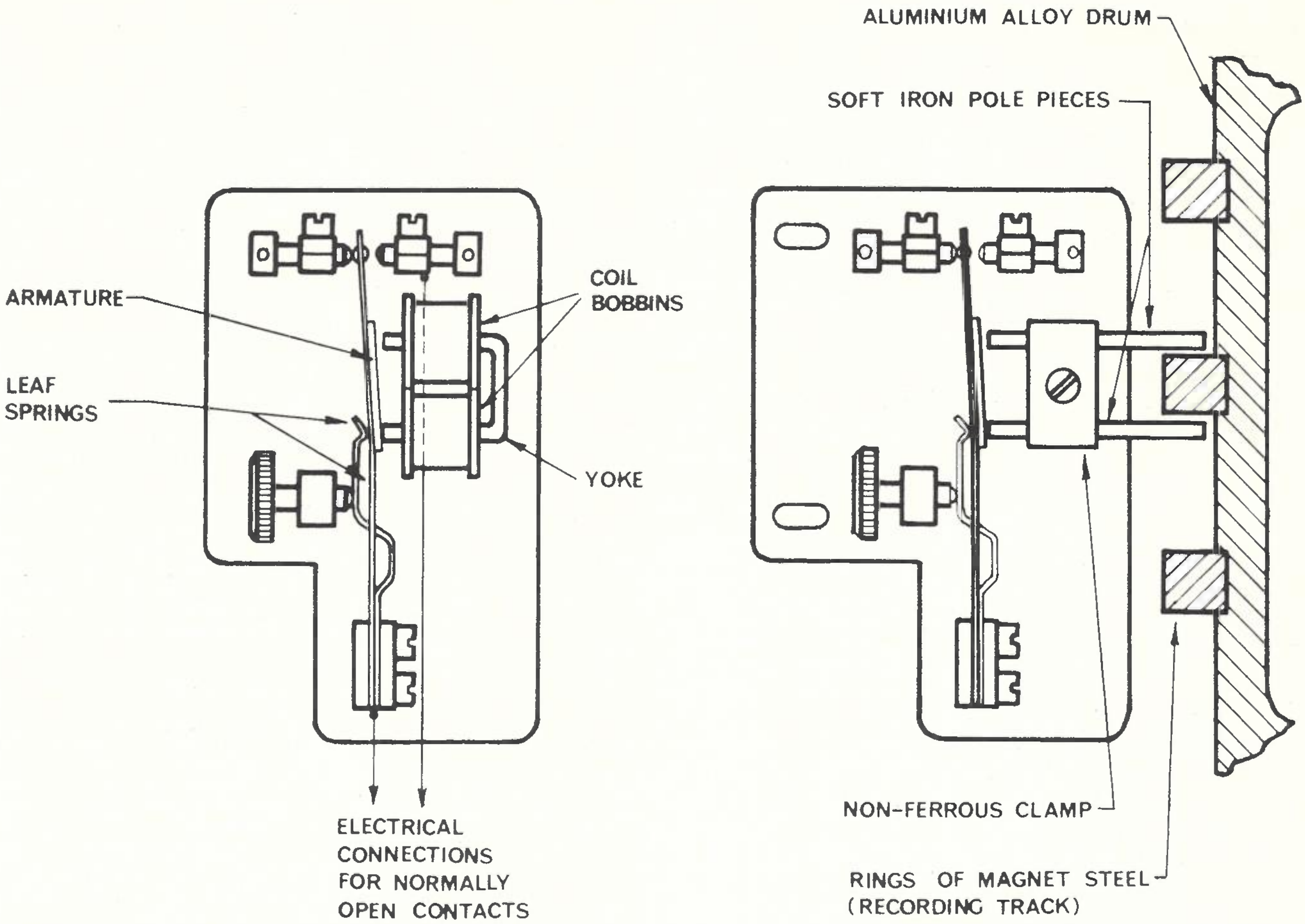

Fig. 10 — Siemens High Speed Relay. Left: Before modification. Right: After modification

showing the redesigned pick-up head, based on the reed relay, is shown in Fig. 11.

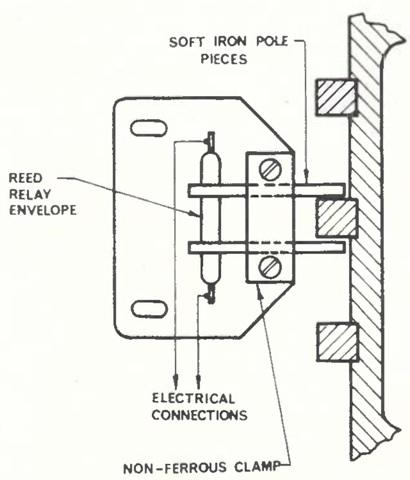

Fig. 11. — Pick Up Head Using Reed Relay.

Drop panels at the edge of the conveyor are actuated by pneumatic cylinders. These are controlled by solenoid-operated direction-control valves. It was hoped initially that a 50 volt d.c. supply could be used in the solenoid circuits because a potential difference of 50 volts does not exceed the rated switching voltage of the Siemens High Speed Relay contacts. A 50 volt d.c. solenoid-operated direction-control valve is shown in the left foreground of Fig. 9. Later on, it was found that 230 volt a.c. operated valves are more easily obtained and are probably more reliable. The decision to change to 230 volt a.c. operation necessitated the incorporation of "diverter relays" between the Siemens High Speed Relay contacts and the direction-control valves. These diverter relays are conventional 3000-type relays carrying microswitches.

Recording Heads

Each recording head comprises a U-shaped core of low reluctance iron with a self supporting winding on each leg, separate pole pieces being attached to the leg ends after installation of the windings. Since it is important to produce a high intensity of magnetic flux at the relatively small face of the pole piece, a special sintered ferrous metal possessing an abnormally high saturation flux density was used for the pole pieces. Because the duty cycle factor of the recording heads is small, a very large current density (1500 amps. per sq. cm.) can be used in the windings without causing overheating. In the prototype machine, the recording heads were supplied from a 48 volt d.c. source via relays actuated by the destination push buttons and a phototube light gate. Passage of a parcel through the light beam determines the instant at which the relevant marker pulse is recorded, thereby eliminating variations in timing which would otherwise occur due to lack of synchronisation of the twin operations of loading the parcel onto the conveyor and pushing the appropriate button.

Erasing Heads

Removal of recorded pulses from each memory ring is achieved by an erasing head consisting of a laminated stalloy core with a single winding continuously energised from a 32 volt 50 c/s a.c. supply.

Memory Drum Drive

It has been mentioned already that there are 24 recording tracks, each measuring about 14 in. in diameter, these are carried in groups of six on four cast aluminium alloy drums which are rotated by a roller chain and reduction gearing drive from the tail pulley spindle of the belt conveyor. The use of a fixed-ratio drive ensures that the memory delay intervals are accurately related to conveyor belt for the operation of the recording head on one of the annular steel rings, and the parcel is transferred from the face up belt to the main parcel conveyor belt.

The circuit is not completed however, until the parcel interrupts a light beam of the photo-electric gate, when a mark is registered on the steel ring. The parcel is then conveyed along the belt in synchronism with the travel of the mark on the ring, to the point where the parcel has arrived at the selected drop panel, at which point the mark passes through the jaws of the reading head, which operates and closes the circuit for the electro-pneumatic drop panel mechanism. The drop panel door opens and allows the parcel to slide off the conveyor belt. The mark on the ring is then cleared by the erasing head before again passing through the recording head.

The electro-magnetic memory system is preferred because of its simplicity, reliability of operation, and exceedingly low maintenance cost. There are however several other methods by which keyboard selections may be held in store to perform subsequent operations. Those already used as an alternative with the parcel machine are:

(i) The use of pin wheels, one for each selection driven in synchronism with the conveyor belt. This modification to the Australian Post Office design has been used by the British Post Office.

(ii) A system combining a cold cathode tube shift register with diode logical circuitry to perform all memory and control functions.

This was on trial in Melbourne and proved more difficult to maintain in correct working order than machines equipped with electro-magnetic memory, and a change over to the magnetic memory has been undertaken.

(iii) Other methods utilising magnetic or perforated tape may be quite feasible.

Keyboard

The keyboard (see Fig. 13) is positioned to enable the operator to sort in the seated position with one hand. Having regard to the varying size of parcels the machine output rate is close to 45 parcels per minute.

There are twenty-six selections on each of the primary machines, and a relay stores the designation keyed by the operator if the preceding parcel has not yet interrupted the light beam of the photo-electric gate. This increases the speed at which a sorter may key. Earlier type machine keyboards did not have this facility; instead, they had an indicator lamp that was illuminated until the keyed parcel passed through the photo-electric gate, and if an operator keyed a second designation before the lamp went out then a mis-sort occurred. The memory with the facility to store a keyed designation has overcome this problem and allows the operator to sort without checking the condition of the indicator lamp, and as a result helps to increase the sorting rate.

Fig. 13. — Sorting Keyboard and Face Up Belt.

Operator training on the keyboard does not present any difficulty and within a few hours an operator can reach a satisfactory rate. Operators must be experienced in manual sorting as they are required to associate a geographical area with a particular key. No purpose is served by the use of extraction codes, as the keying rate of the operator is limited to the output of the machine, i.e. 45 per minute. If the number of primary selections is increased to provide for detailed sub-divisions, then a more complex keying arrangement would be necessary.

Sloping Belt

The conveyor belt is 18 inches wide and is horizontal at the transfer point where the face up belt terminates. It rises rapidly to a transverse slope of 37° above the horizontal plane along its upper edge, and returns to the horizontal at the driving drum within the head unit. The belt is made of felt, 3 ply canvas or other suitable light weight belt material, faced on the upper surface with red polyvinyl chloride. The belt travels along a masonite faced decking at a speed of approximately 180 feet per minute.

Along the lower edge of the decking and at right angles to it is a shelf 5 inches wide, surfaced with a highly polished hard material (Laminex or similar material). The lower edge of the belt is in contact with this material and the P.V.C. is kept out of contact with this material by stopping it ¼ inch short of both edges of the belt. It was found in practice that if the P.V.C. was extended across the full width of the belt, its edge in contact with the shelf became heated after lengthy periods of operation and resulted in a stickiness adhering along the shelf, causing operational and maintenance problems. The reason for both edges of the belt being treated in this manner is for longer belt life, as the belt may be turned around and the upper edge then becomes the edge in contact with the shelf.

The machine has been designed to handle parcels up to 22 lbs. in weight with length not exceeding 3 feet. If provided with a wider conveyor it can be used for heavier articles of greater bulk than those of the average parcel, and is used for distribution of bagged mail.

Drop Panels

Along the sloping belt length are drop panels 3 ft. 6 in. in length, spaced to meet the particular requirement. Each drop panel can be operated and restored rapidly by an electric pneumatic arm activated via the memory system. The panel drops and the parcel slides from the conveyor. A chute is fitted on each drop panel to facilitate entry of the parcel into the floor conveyors. (See Fig. 5.) The end drop panel is always in the down position with a wheeler bin or basket placed

THE OTHER ARTICLE SYSTEM

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INTRODUCTION

Whilst several pages of the "Post Office Guide" are devoted to completely listing all postal requirements for other articles these may be more simply defined for postal purposes as any article which is not a letter or does not contain perishable substances and is within the maximum weight and size restrictions. In essence, articles other than letters or parcels, hence the name of this type of mail overseas is "Articles Other" or A.O. In Australia this is reversed and the short title is O.A., by which we will frequently refer to them in this article.

The majority of articles handled are small packets (maximum allowable weight 1 lb.) and newspapers, periodicals, books and catalogues (to a maximum weight of 6½ lb. if bundled together to the same addressee but a single book to 11 lb. weight is acceptable).

DEVELOPMENT OF MECHANISED HANDLING

Vertical Faced Machines

Some 40 years ago it was evident to the Australian Post Office that the mechanisation of mail handling processes would be necessary to enable the large and ever increasing volume of mail to be handled expeditiously, and in 1928 the first machine for handling O.A.'s was installed in the Brisbane Mail Branch for trial purposes. It consisted of a vertical sorting face with back clearing doors discharging on to a two foot wide conveyor belt thence into bins at the end of the conveyor. The doors on the back of the sorting field were not opened automatically, but were controlled by short levers, somewhat similar to a railway signalling system, at the discertion of an operator located at the end of the clearing belt.

In 1929 a similar type of machine with considerable improvements and of more solid construction, was installed in the City Section of the Melbourne Mail Branch. This machine included automatic mechanically controlled clearance of sorting bins on to a conveyor with time delayed clearance by diverters into storage bins.

A commencement was made on the mechanisation of the Mail Branch in the Sydney General Post Office in 1930 when an O.A. system based on the design of the machine used in Melbourne was installed. Machines with their automatically controlled distribution conveyors, diverters and inter-linking conveyors were installed for primary, suburban, interstate and overseas sorting. The sorting machines in this system were designed with a number of similar sorting fields placed side by side in the vertical plane, each field consisting of a number of bins into which mail matter was sorted. The sorted articles, which were discharged from the back of the sorting fields at timed intervals, were conveyed by flat distribution conveyor or belts to the various receiving points At selected points along the distribution belts, diverter flaps deflected the groups of mail to their particular storage hopper. A Departmental Committee at that time reported that the actual savings were £20,000 per annum and a considerable improvement was effected in the grade of service. The plant however, as well as occupying considerable floor space, was of heavy steel construction with a high operating noise level.

Horizontal Faced Machines

In 1947 when consideration was being given to the mechanisation of mail handling facilities in other States, the primary requirements associated with the mechanical handling of O.A.'s were closely examined. Entirely new equipment was conceived and developed in the form of horizontally faced sorting machines which reduced the fatigue to the sorting staff by providing more comfortable and improved working conditions, considerably reduced the noise level of operation of the machine, and generally enabled better supervision of staff. The principle of unit construction was the underlying basis of development of machines at this stage, so that the machines could be easily extended and readily repositioned if necessary.

The first of these machines was installed in the Melbourne Mail Branch in 1947 for trial purposes, and the success of this trial installation, which was the forerunner of O.A. machine systems as we now know them, can be gauged by the fact that the Mail Branch Administration would not release it from service until it could be replaced by a factory produced machine. This was done in 1959 some 12 years after the initial installation.

With the increasing demand for mail machinery in all States, efforts were concentrated then on the development and production of these machines and systems as Commonwealth standards.

CONSTRUCTIONAL DETAILS

Machines

An O.A. sorting machine is essentially a multiple of sorting fields each composed of the appropriate number of receptacles, with an input feed of unsorted articles and a cyclic delivery arrangement to take the sorted articles to the next sequential operation. A general view of the primary sorting machines in the Sydney Mail Exchange is shown in Fig. 1.

Inherent in its design is the capacity to co-ordinate the output of work of a large group of sorters and automatically deliver it to the intended

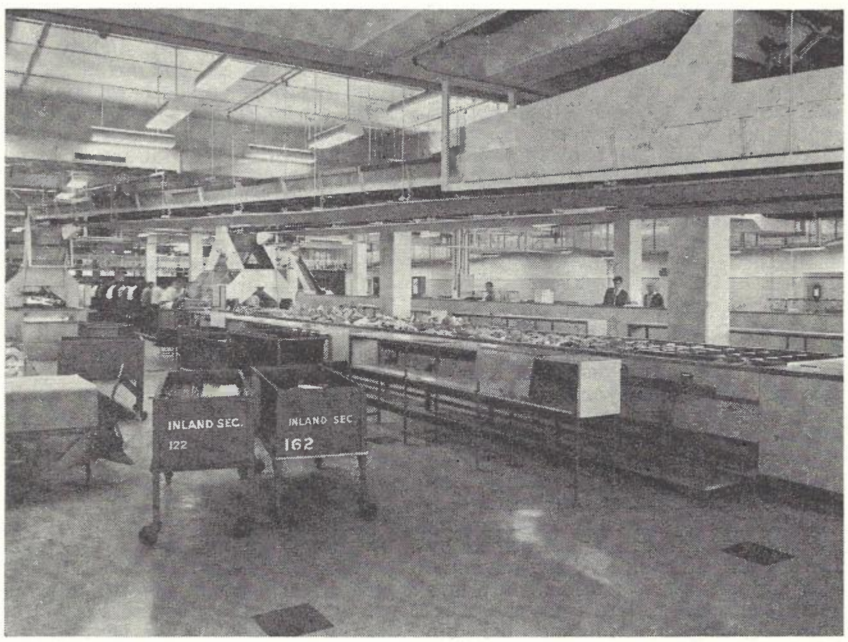

Fig. 1 — General View of Other Articles Primary Machines.

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sorting system, using the horizontal faced sorting machine.

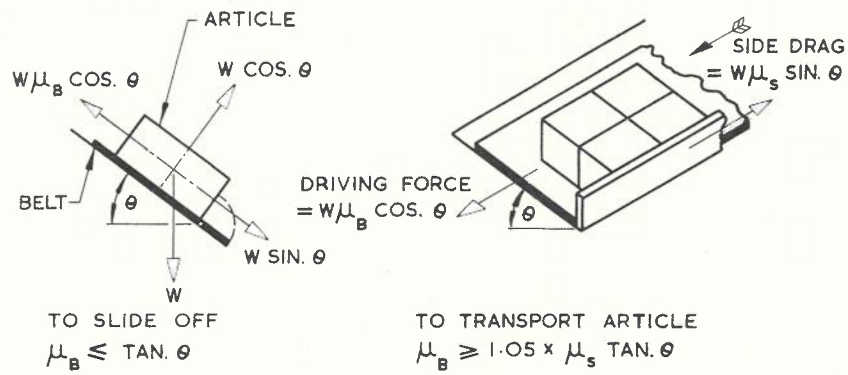
The sloping belts used on the O.A. distribution channels at Sydney Mail Exchange are tilted to 37° above the horizontal in all the centre sections of each conveyor with the belts returning to the horizontal in each end unit as the head and tail drums are placed horizontally. The side of the channel is at right angles to the base and is 10½in high, with drop panels as required, hinged at the junction of the side and bottom of the channel. The drop panels are operated by compressed air cylinders located at the rear end of each drop panel, viewed in the direction of traffic flow. This is to ensure that a leading edge is not presented at the edge of the fixed part of the channel wall.

The belt surface has a resultant coefficient of friction with the wrappings of the articles carried which is greater than that between the articles and the side wall otherwise the articles are not carried along the channel. Also the relation between belt and articles must be such that these will readily slide off the belt when drop panels are opened.

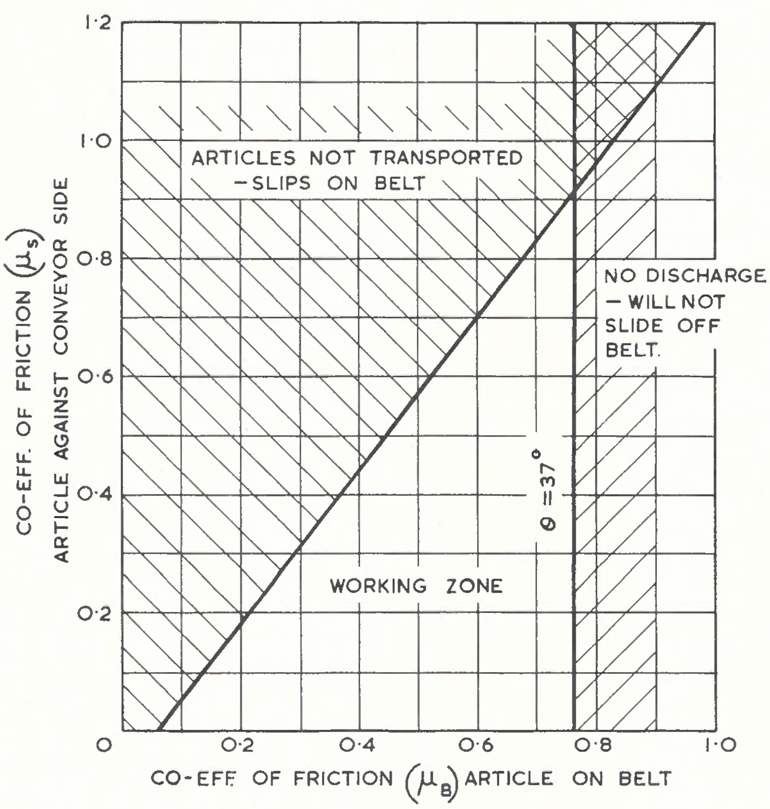
Fig. 3 illustrates the conditions required for the successful operation of these conveyors.

The most satisfactory material for use as a sloping belt surface has proved to be polyvinyl chloride which is used as a coating layer about 1/16in thick on the top of a felt conveyor belt on the O.A. systems in this exchange.

Mention has been made of the speeds of belt in the delivery conveyors of the O.A. systems. These are progressively reduced in order to compact the loadings discharged from the sorting machines into short groups of articles continuously placed on the sloping belt to ensure good discharge through open drop panels.



(a) FORCES ACTING ON ARTICLE FOR HORIZONTALLY RUNNING SLOPING BELT.



(b) GRAPH SHOWING RANGE OF FRICTION CO-EFFICIENTS FOR THE SUCCESSFUL TRANSPORT AND DISCHARGE OF ARTICLES USING A TRANSVERSELY–SLOPING CONVEYOR BELT.

Fig. 3. — Frictional Characteristics of Sloping Belts.

Traffic Aspects

On a day of heavy postings the new exchange at Redfern now handles up to 700,000 pieces of this class of mail but about 100,000 of these do not pass through the primary sorting stage. In order to minimise operating costs the Department arranges with heavy users of its services, where possible, to lodge their postings in a presorted form. In many cases this is acceptable to the clients as the addressing system used has its addresses in district group order enabling these articles to be introduced into the system at the secondary sorting stages.

This present peak day load of 700,000 O.A.'s has a total volume of about 14,000 cubic feet and weighs approximately 100 tons. These figures will convey some idea of the size of the daily task in dealing with this mail. In the period prior to Christmas the loading is about 30% greater and it is expected that within 20 years the daily quantities of O.A.'s handled will have doubled.

The sorting capacity or throughput of the presently installed three primary machines is 75,000 O.A.'s per hour, with the machines staffed with a full team of 36 sorters on each. The addition of a fourth machine is envisaged when this is needed and space is available for its installation. The hourly output would, of course be increased by 33%.

The equipment provided at the secondary positions is proportionate in capacity to that of the primary and the whole of the traffic linkage is shown on the flow diagram on Fig. 6 on Page 209. The direct flow of bulk posted articles to secondary sorting positions, referred to earlier, has been omitted from the diagram for the sake of clarity. Consequently the diagram shows the O.A. flow commencing on the fourth floor at the mail opening and packet stamping positions.

The time of arrival of mail at the exchange is governed by the posting employing an eight bank uniselector and 3000 type relays (see Fig. 4) in the control circuity which were in-

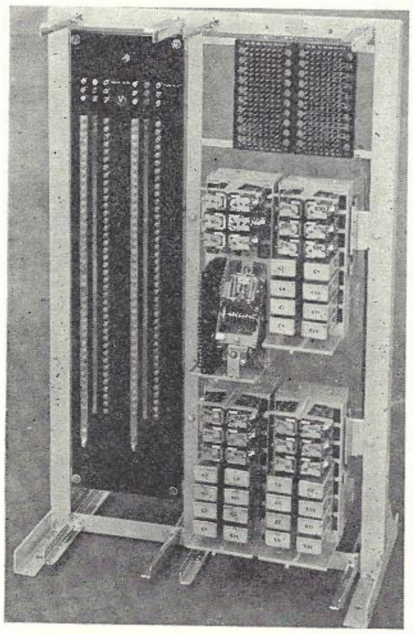


Fig. 4 — Typical Rack-Uniselector Control.

stalled in the mail exchanges in all capital cities following the acceptance of the horizontal sorting faced machines as a standard. Fig. 5 is a simplified schematic wiring diagram showing only two of the 8 uniselector banks.

A switch SWA operated by a pulse timing cam on the machine causes the uniselector to step, say once every 4.5 seconds.

Three further switches SWB, SWC and SWD, mounted on the machine are operated by the bin door operating rod.

With SWB in its closed position the high and low pressure closing air valves are actuated causing the rod to be held in the back position and holding all bin doors closed.

When the uniselector steps to a contact that is strapped to a bin door circuit, the bin door relay operates the selected bin door relay latch magnet which in turn releases the catch holding the bin doors closed. At the same time the operation of relay A causes air to be disconnected from the high and low pressure closing valves and connects the low pressure opening valve, causing the air piston to force the operating rod forward and allowing the selected bin doors to open.

On commencement of the forward stroke SWB is operated preventing any further stepping of the uniselector until the bin doors are closed. SWC also is operated shutting off the low pressure opening air valve and causing the low pressure closing air valve to operate and the operating rod to commence its returning stroke. At this moment SWC, which has a delay make period of two seconds, is released, but the operating rod should return to its orginal position within the 2 seconds before SWC is restored.

SWB restores during the last $\frac{1}{4}$ in. of the return stroke, operating the high pressure closing valve and causing the operating rod to be forced fully home thus ensuring that all bin doors are closed and latches free to operate.

Switch SWD, which has a delay make period of five seconds, is operated at the end of the closing stroke.

With the closing of SWB the uniselector recommences stepping and after the first step releases the bin door latch magnet, so ensuring the bin doors are locked closed. Between the stepping of the uniselector and the next stepping impulse, switch SWD makes.

If on the return stroke of the operating rod a bin door is accidentally jammed open, the operating rod cannot return to normal therefore SWB is not restored to normal, SWB does not operate and the uniselector is not stepped to a new position.

After two seconds SWC closes disconnecting the closing air valves causing the operating rod to move forward, re-opening the bin doors and allowing an extra clearing period. The operating rod restores to normal as already described.

If the operating rod does not return to the backward position in a reasonable time a relay which is normally operated will release bringing up an external alarm bell and lamp.

Timing Devices

Mercury switches were originally used for switches SWA, SWB, SWC and SWD but considerable trouble was experienced particularly with the delayed make and break switches SWC and SWD in which tolerances allowed above and below the speci-

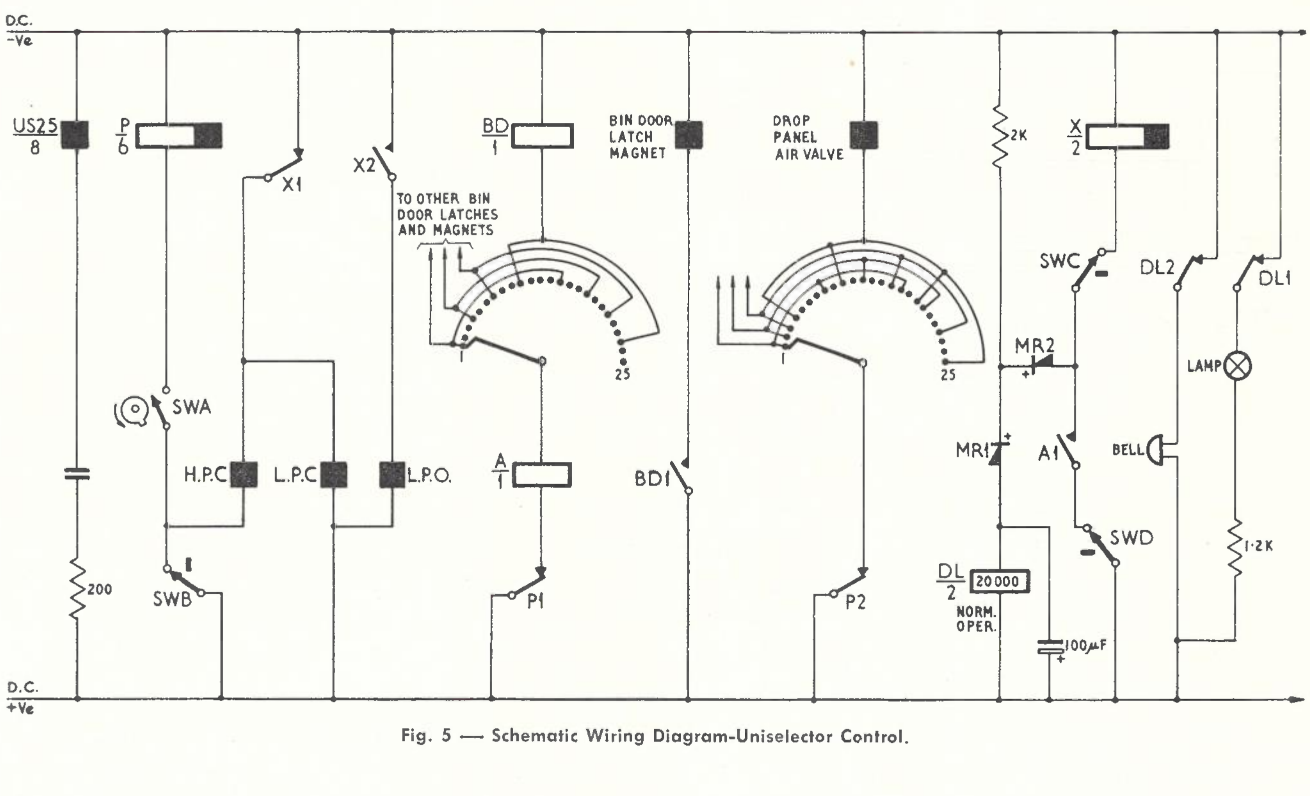


Fig. 5 — Schematic Wiring Diagram-Uniselector Control.

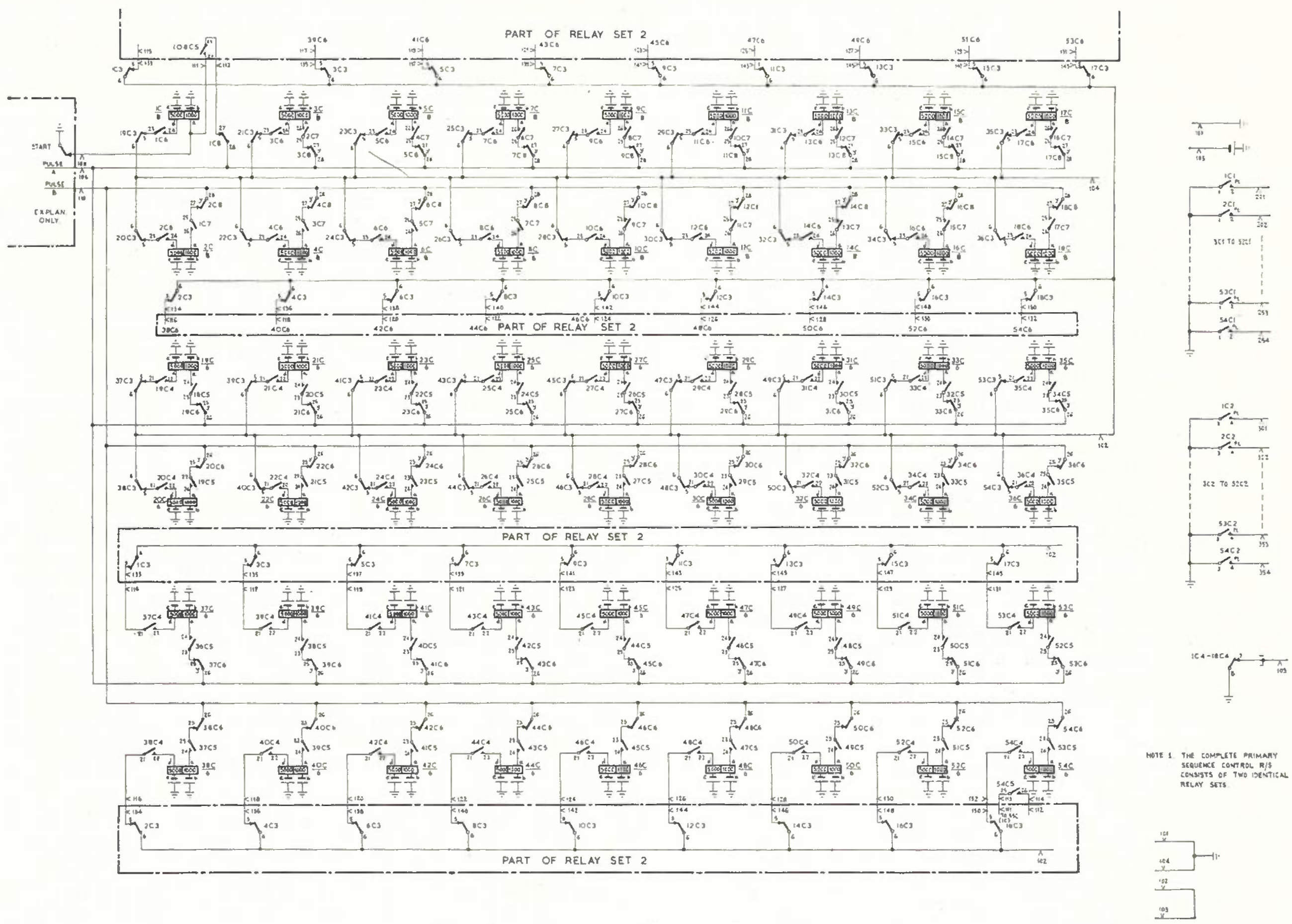


Fig. 8. — Sequence Control, O. A. Primary.

Sequence Control Unit

The sequence control unit for the O.A. primary sorting machine system (see Fig. 8) comprises 108 relays, in two identical banks of 54 relays each stepping at 1 second intervals to give the full cycle of bin clearances in 108 seconds.

When battery is connected from the fourth floor cubicle relay 1C (a-b) is energised via the normally closed contact S1 causing seven of the eight contacts of the relay to operate as follows:—

1C1 Connects earth to output terminal 201
1C2 Connects earth to output terminal 301
1C3 Releases 37C (d-e) via terminals 115/133 and contact 37C4
1C4 Removes 1st of 18 parallel earths from the common hold line
1C5 Not used.
1C6 Holds relay 1C (d-e) through 19C3 to earth ,
1C7 Energises 2C (a-b) via 2C8 (N/C)
1C8 Operates after all others. Removes 1C (a-b) operating path to pulsing earth via 54C5 (108 C5 in relay set No. 2).

At this stage, the starting contact is operated releasing 1C (a-b).

Relays 2C to 18C operate similarly, successively extending earths to output terminals 202 to 218 and 302 to 318 at 1 second intervals as provided by the pulsing earth A and B. 18C4 removes the 18th of the parallel earths on the common hold line, releasing any operated relays from 19C to 54C. 18C5 energises relay 19C (a-b) via 19C6 (N/C).

The contacts of relay 19C then operate as follows:—

19C1 Connects earth to ouput terminal 219
19C2 Connects earth output terminal 319
19C3 Releases relay 1C (d-e). 1C4 restores the earth to the common hold line
19C4 Holds 19C (d-e) through 37C3 (N/C) to common hold line
19C5 Energises relay 20C (a-b) through 20C6 (N/C)
19C6 Operates after all others, releasing 19C from pulsing earth A. Relay 19C releases when the earth pulse is removed from pulsing earth A.

Relays 20C to 54C operate similarly, successively extending earths to output terminals 220 to 254 and 320 to 354 at one second intervals. 54C5 energises the first relay of relay set No. 2 (55C).

Relay set No. 2 operates in an identical manner to Relay Set No. 1, the final relay in Set No. 2 (108S) energising relay 1C in Set No. 1 and the next 108 second cycle commences.

Timing Selection Panel

The impulses for the operation of the bin door relay sets and the drop panel relay sets are obtained through the timing selection unit which consists basically of a terminal panel in which the appropriate strappings are made to give the necessary time intervals between the operation of the bin doors in the machines and the drop panels and diverters throughout the conveyor distribution system.

Bin Door Relay Set

A bin door relay set is provided for each O.A. machine. These sets consist of 6 relays (A to F), each with 3 contacts, for operation of the bin door latch magnets and two further relays (BO and BC) for the operation of the bin door opening and closing air valve solenoids. Relays A to F operate similarly, normally at 18 seconds time intervals in the case of the primary machines, and therefore the operation of relay A (a-e) only will be described.

With the earth extended to "a" terminal of relay A, the relay operates, further extending the earth through two of its contacts A1 and A3 to the low pressure open solenoid is energised through RE3 causing operation of the air cylinder and operating rod and allowing the bin doors to open again. SWC is then operated again and recycling commences.

As mentioned earlier relay RA is energised as soon as power is connected. Relay RF is energised through delayed contact RAI. Contact RF1 which is also a delayed contact removes 240V AC supply from the "Clearing belt" relays and operates the alarm and warning lamp. The delay in contacts RA1 and RF1 is arranged so that if a jam does not clear itself within 3 re-cycles, the clearing belts will stop. If the jam is cleared within 3 re-cycles, SWB and RB will be operated.

Relay RG is energised through delayed contact RB1 and RG1 releases solenoids and relay RA. Contact RA1 releases before the delayed contact has time to operate preventing RF from being operated. Whilst RG is operated, the "clearing belt" stop buttons may be operated, stopping and clearing belts. Whilst RG is released (i.e. bin doors open) the stop button will be ineffective in stopping the re-cycling circuit until the delay on the open contact releases.

MAIL WEIGHING

To facilitate the compilation of statistics of newspaper and packet traffic handled in the Mail Exchange, an automatic weighing system is to be incorporated in each of the flow routes from the primary machine to register the weight of mail sorted to each of the primary destinations.

The method of obtaining these statistics at present is by hand weighing some of this class of mail, selected by sampling methods and estimating the remainder on a volume basis.

A combined mechanical and electronic device has been developed to automatically weigh the mail matter while in transit on the conveyor belt without interruptions or alterations to the normal sorting and distributing procedures. Actuating heads or weight sensing devices are built into the conveyor channels to provide accurate sensing of the weights of all mail conveyed on the belts, regardless of the shape and size of the individual articles and the belt loading density.

Approximately 10 in. in front of the mail weighing area the side panels of the conveyor channel are cut away at belt level to accommodate a P.E. cell and light sources on opposite sides of the channel for the purpose of detecting the presence of mail on the belt. Both of these openings are covered with a plate glass window to ensure that no obstruction is presented to the flow of mail matter along the conveyor channel.

The mechanical section of the weighing head unit consists of a roller spring mounted on a frame fitted under the channel conveyor belt so that the roller is in contact with the underside of the belt. The frame is mechanically linked to an aluminium vane which moves between a set of 4 coils in a transducer. The two coils on the input side are connected in series aiding and are supplied with 20 Kc/s at 10V R.M.S. The output coils are connected in series opposing such that the output voltage is proportional to the displacement of the vane. A weight of 11 lbs. gives a vane displacement of 0.025 in. and an output from the head of approximately 1V r.m.s.

The output from the head is fed into a multiplier unit where an amplifier produces a — ve d.c. voltage proportional to the a.c. input voltage. This voltage is gated with the output from the 32 c/s oscillator by means of two diodes. A capacitor which is charged to a potential on each pulse from a pulse shaper presents its voltage to a current switch which is on only while the capacitor is charged — ve with respect to earth. During the pause between pulses the capacitor is discharged to a potential of + 0.5V. A pulse is thus developed which has width proportional to the weight and period equal to the pulses from the pulse shaper. This pulse then is gated through a diode which is connected to a P.E. cell control unit and also through two other diodes to give an output which is fed into the decade counters which in turn give an output to subscribers' meters calibrated to read in units of 10 pounds.

The P.E. cell mounted on the conveyor channel adjacent to the weighing head is a photo transistor which switches off when the beam of light from the light source is blanked off by the movement of mail along the conveyor channel. The output from the cell is fed into a control unit which includes a trigger circuit and timing unit in which a capacitor charges as soon as the light beam is interrupted. When the beam is restored the capacitor discharges through a resistor, the time constant being governed by the capacitor and the resistor. The voltage across the capacitor is fed to a switch which comes on when the capacitor is negative with respect to earth. An inverting switch in the control unit circuit gives a — ve output for the multiplier, thus when mail breaks the light beam, the collector of the inverting switch goes —ve allowing the unit to weigh. A turn off delay is provided which allows sufficient time for the mail to clear the weighing head.

The equipment is mounted on a telephone type rack accommodating up to five sets of channel equipment. Power supplies and oscillators are common to each set of channel equipment and are mounted in the common equipment section of the rack.

CONCLUSION

The present system of sorting O.A.'s at the Sydney Mail Exchange involves handling each article and recognising the address at each sorting operation and it seems unlikely that any other method will be used in the foreseeable future. O.A.'s vary tremendously in their physical characteristics so they cannot be stacked in an orderly manner nor can they be relied upon to retain a constant position on a belt when being transferred from one operation to the next. Thus, the O.A.'s differ from letters which can be stacked for presentation for address reading and code marking, code marked on flat surfaces, transported by conveyor without losing facing and position, restacked for automatic sorting, transported again and stacked once more.

It is difficult to imagine that O.A.'s could be subjected satisfactorily to these sorting and handling methods. It would appear, therefore, that even should O.A.'s bear coded address symbols, the present system with several handlings from primary to final sorting will continue. The use of code symbols in the addresses, could, however, simplify and speed up each successive sorting operation.

ACKNOWLEDGMENT

The authors wish to acknowledge the information made available by the equipment contractors, Telephone and Electrical Industries, Pty. Ltd.

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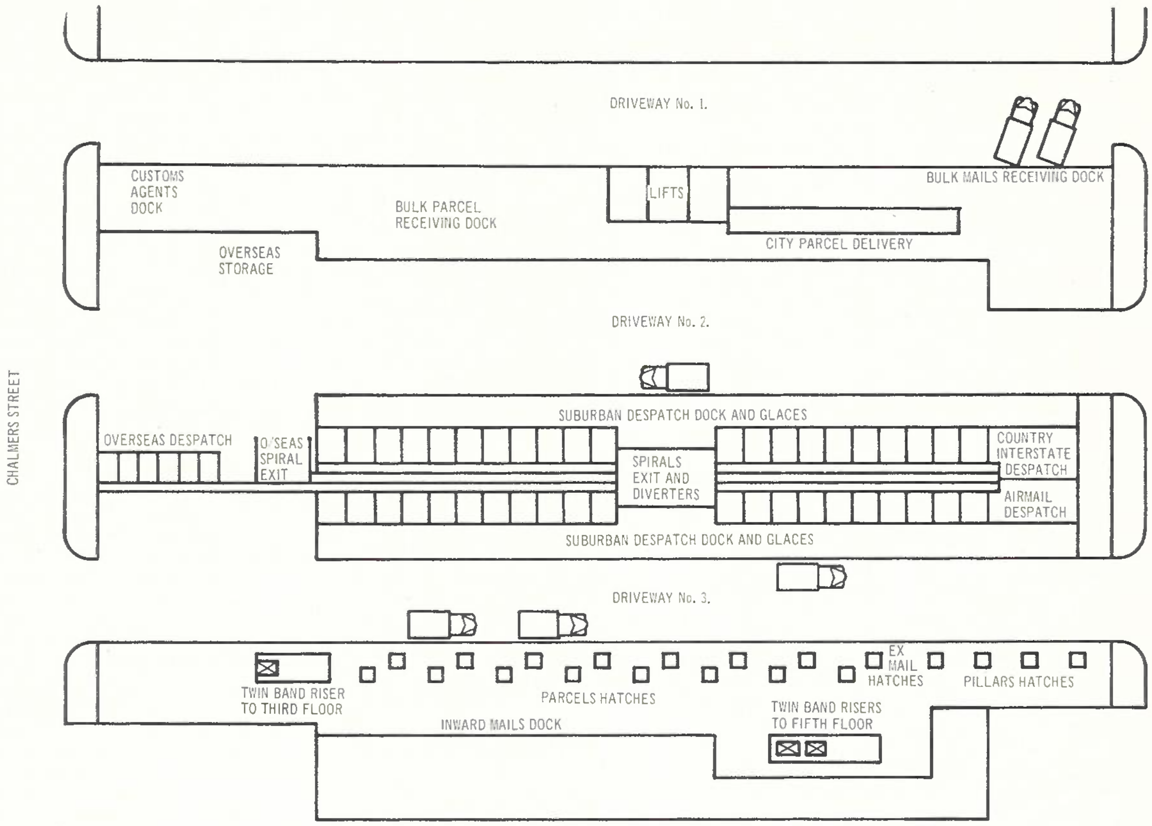

Fig.1 — The Layout of the Docks on the Upper Ground Floor (Street Level).

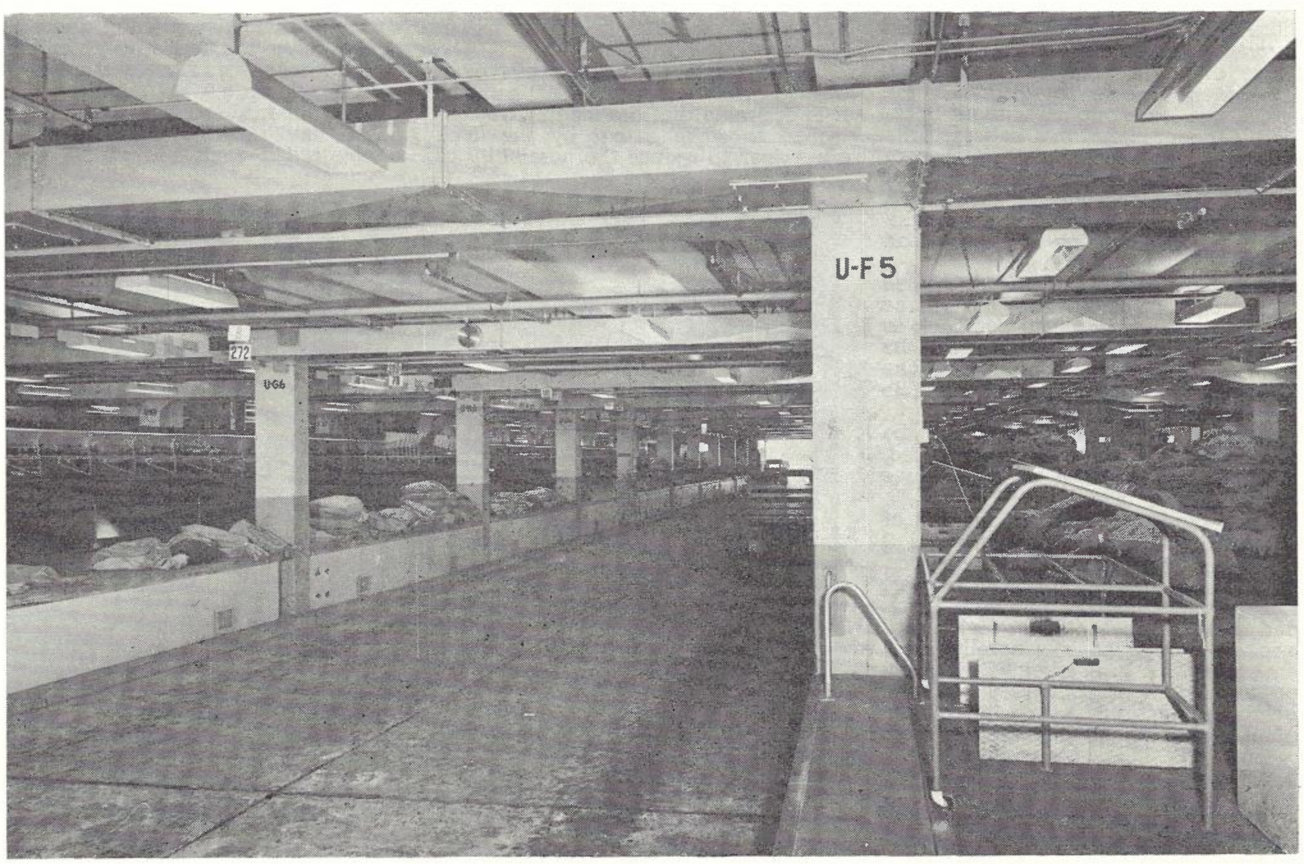

Fig. 2 — View Looking West Along the Driveway Between the Inward Mails and Suburban Despatch Docks.

are divided into sections for each "duty run". The glacis is a 20 degree sloping platform which receives bags from the sloping delivery belt through the drop panels and allows the bags to slide down and gradually build up to a total of approximately 50 bags in each section. As the lower bags are removed for loading into the vehicle, the stored bags slide down the glacis for removal.

Country, interstate, and airmail bags are loaded from the western (Pitt St.) end of the centre docks. Overseas mails are deposited from the sloping belt into selected containers, which are then stored awaiting delivery to the wharf.

Bulk mails, are received on the southern dock, and parcels for city delivery by contractors are despatched from this dock. Customs agents also use this dock for loading parcels received from the Customs area. A delivery belt from the Customs section is provided to lift the parcels to the agents' dock.

INWARD BAG SYSTEM

A schematic of the inwards bag system is shown at Fig. 3. There are three main input systems, parcels, ex-mails and pillars, each with its own twin band vertical conveyor. Incoming bags are deposited on a dock conveyor belt through hatches in the dock as they are unloaded and checked off the mail vehicles. A hatch and checking desk are shown at the right of Fig. 2. These dock conveyors follow usual practice, being 24 in. wide, and running at 100 ft. per. min. One unusual feature is that the return belt for these conveyors runs under the lower ground floor ceiling, and the weight tensioners are also located in the lower ground floor area. This arrangement calls for a more involved belt path, but allows a saving in overall building height, and facilitates maintenance.

The location of the input to the twin band vertical conveyors for the ex-mails and pillars is dictated by the discharge points for these conveyors on the 5th floor. Because of this, the dock conveyors feed each twin band via three quarter turn spirals and two conveyors. A special room is provided in the building for this equipment, at the foot of the twin band conveyor vertical chase.

The parcels twin band vertical conveyor input is in a well in the dock, and is fed direct from the dock conveyor via a rising conveyor and chute as shown at Fig. 4. It was not practicable to locate the input and drive for this parcels twin band in the lower ground floor, as the Customs public counters are in this area.

The pillars and ex-mails twin band vertical conveyors run up a specially provided shaft in the building, with maintenance access from every floor. Space is provided for a third conveyor at a later date.

The twin band conveyors discharge in a room on the 5th floor, and the bags are carried by chutes through the floor into the 4th floor area at just below ceiling level. The chutes direct the bags on to conveyors which carry the bags to their respective opening glacis.

The parcels twin band conveyor runs up to the 3rd floor, where it discharges either to the Customs area for overseas mails, or the local opening area, both on the 2nd floor.

Twin Band Vertical Conveyors

In this specialised form of conveyor, the bags are transported vertically, for a height of 90 feet for the two largest conveyors, by "clamping" them between two rough-surfaced rubber conveyor belts, moving in a smooth-walled shaft, or conveyor housing. Belts move at a speed of approximately 200 feet per minute. Fig. 5 shows the general arrangement. Because of the unusual nature of this conveyor, some of the design details are explained below.

Bag Holding: The clamping force or pressure to carry the bags vertically is provided by sets of pneumatic tyred wheels, mounted on a pivoted

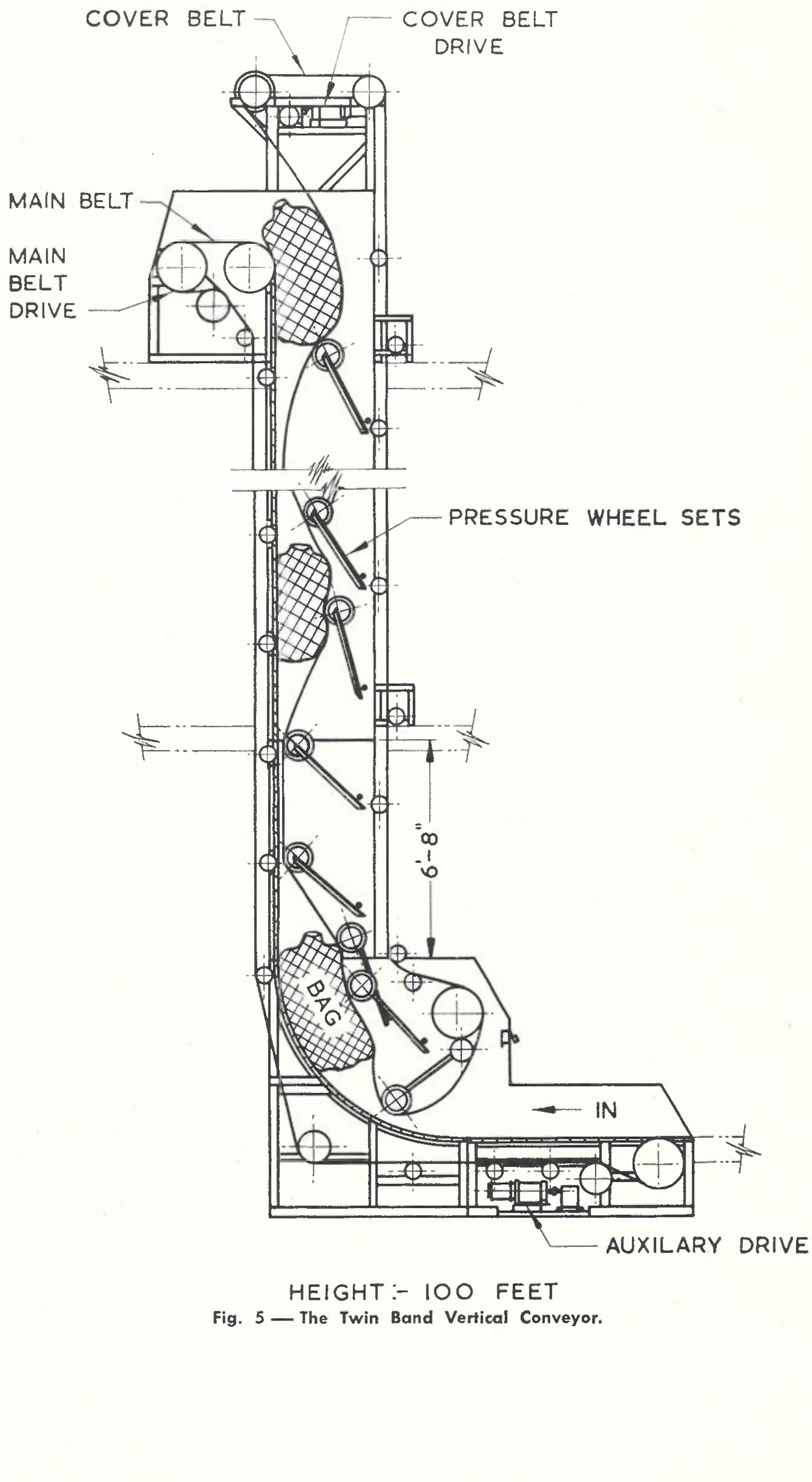

Fig. 5 — The Twin Band Vertical Conveyor.

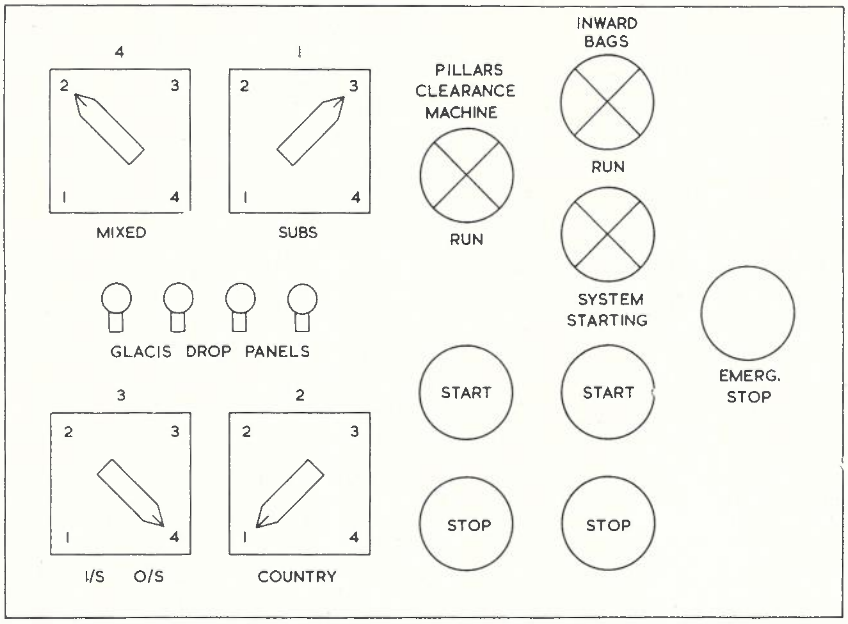

Fig. 7 — Control Panel - Pillars Opening.

diverter at the exit to the twin band vertical conveyor, to direct bags to Customs or local opening glacis.

General: All conveyors in any system are electrically interlocked, so that the failure of a conveyor would stop all conveyors feeding on to it, preventing a jam and possible damage to mail. Emergency stops are provided throughout the different systems, and these, once operated, can only be reset by a key held by the technical staff. Additional lockable isolating switches are provided at intervals up the vertical conveyor shaft for each conveyor, to allow a technician to lock off a conveyor when working on it.

The working floors are divided into sectors for alarm indication, and a fault is indicated by a lantern depicting the type of fault in the sector concerned, and in the maintenance room on that floor. Control relays, contactors, fuses, etc. for the systems are located in cabinets on each floor, to facilitate maintenance.

Mail Bag Opening

The terminating point for most bags coming into the Mail Exchange is a mail opening position where the bag is opened and broken into the various categories of mail which it may contain. There are four separate points at which bags are opened — for bags of ordinary or Customs parcels, and pillars or ex-mails. The general scheme is shown in Fig. 3, where bags from the dock are raised by a twin band vertical conveyor to the appropriate floor, and delivered to a wide storage glacis, awaiting opening.

Ex-Mails Opening: Bags of ex-mails arrive on the fourth floor and are carried on a 2 ft. wide sloping belt conveyor, with drop panels feeding two other 2 ft. wide sloping belt conveyors each running the full width of a 95 ft. wide storage glacis. Bags drop off these sloping belts and onto the top of the 20 degree sloping storage glacis area. The drop panels of each sloping belt can be operated at will by an operator to distribute bags as required to any point of the glacis. Thus bags can be spread over the large sloping storage area of the glacis, the lower end of which funnels the bags to one of seven points ready for opening. The two glacis can store about 560 bags in total.

The mail opening machine shown at Fig. 8, is a suite of three apertures and three conveyors 15 inches wide within one housing, and located at the lower end of the storage glacis. A bag can be taken from the foot of the glacis, rolled about 18 inches to an adjacent hopper with a sliding floor, opened, and tipped into the hopper. Within this bag may be, besides the mail advice form:

(a) a bag of registered articles, which is dropped through a lift-up hatch onto the registered conveyor after checking;
(b) labelled bundles of up to 50 or 60 letters, or perhaps small labelled bags of letters, which are dropped through an open hatch onto the letter bundle conveyor;
(c) oversize packets which are placed on a 2 ft. wide conveyor beneath the glacis and behind the opening machine operator;
(d) the remaider of the mail in the hopper which is newspapers and packets (other articles) can now be dropped onto an O/A. conveyor beneath the hopper, by pulling a handle, shown in the right of Fig. 8.

The empty bag is then tossed onto the empty bag conveyor running beneath the glacis.

Pillars Opening: A glacis system of the same type as is used for ex-mails bags is also located on the fourth floor, so that bags of mail from letter receivers can be opened. The mail opening facility at the lower end of this glacis has four hoppers into which bags are tipped; one being for bags of city mail, which has been earlier posted in a letter receiver slot labelled "city"; one for bags of interstate/overseas mail; one for bags of suburban/country mail; and one for undesignated mail, or "mixed" mail. The mixed mail hopper feeds directly to its own conveyor leading to storage and culling machines, but the three

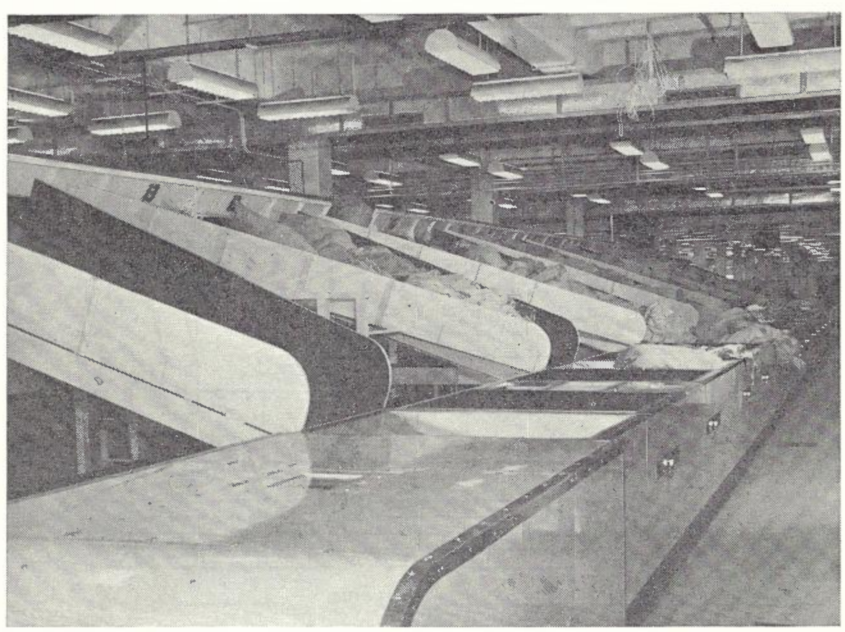

Fig. 8 — Mail Opening Machine and Storage Glacis, 4th Floor.

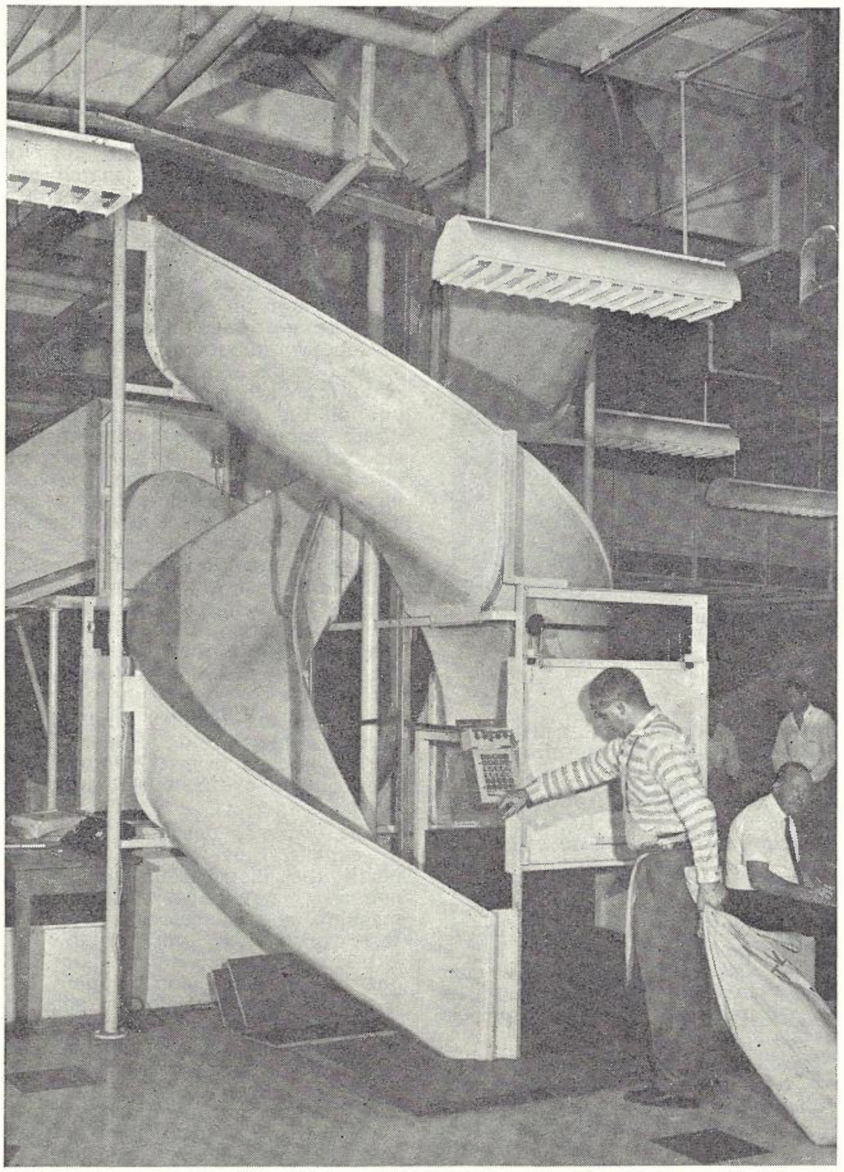

Fig. 10 — A Suburban Despatch Chute on the 1st Floor, Showing the Twin Spirals from the 3rd Floor.

twin concentric spirals each 13 ft. pitch and 7ft. 6 in. diameter.

Timing Requirements: The time taken for a bag to travel down a spiral chute depends on the dimensions and the co-efficient of friction of the bag material. This leads to an anticipated variation of times for different bags. A computer programme estimating these times was available, and some examples calculated by this means indicated that the expected variation was likely to be around ± 1 second, which was within permissible limits for the timing of the suburban despatch system.

Suburban Despatch

To ensure delivery of mail in the suburbs in the afternoon, and yet avoid "tying off" (closing and sealing the bag) too early, a precise rapid delivery of suburban duty runs from the mail floors to the despatch docks is required. During a 20 minute period approximately 500 letter and newspaper and packet bags, and 200 parcel bags have to be checked out and deposited on the docks in the duty runs, and despatched on the vehicles.

The suburban despatch dock is double sided, and the distribution system of bags to the dock is arranged as virtually two separate systems, serving the north and south docks. This gives some operational advantages, as two simultaneous despatches can be made from the mail floors, thus dividing the load, and in an emergency, or under fault conditions, either system could be used to carry the load.

Because the letter, newspaper and packet, and parcel handling areas are on different floors, two bag entry points are necessary into each of the two systems, i.e. the north and south docks systems (see Fig. 11). Also on the third floor, to avoid congestion, and reduce the distance bags have to be moved, two separate hatches (and despatch keyboards), which can be used alternatively as required, are provided for each system. Fig. 11 shows the north dock system, and Fig. 12 shows two despatches and a checker keying out suburban bags for the north and south docks.

The delivery of a bag from one of the hatches on the third floor, to a particular duty run on the dock is accomplished by keying the duty run destination number (one keystroke) and dropping the bag down the hatch where it passes a photo cell. From this point on, the system works similar to the parcel sorting machine and the progress of the bag is timed by a magnetic drum until it reaches the duty run position on the glacis where the drop panel opens and the bag is deposited. Fig. 2 shows one half of the suburban despatch dock in the left hand side of the picture. The diverter which feeds to the eastern or western end can just be seen almost under the clock, to the left of the column.

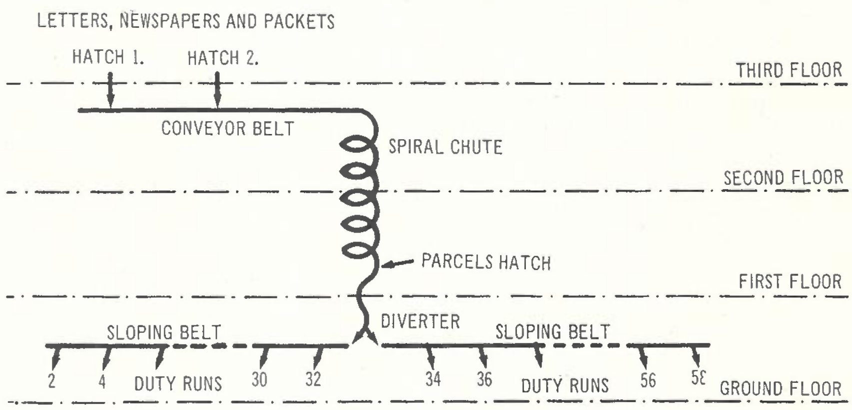

Fig. 11 — Diagram of North Dock System.

After treatment in the bag room, the folded bags are delivered on wheeled trolleys by lift to the working floors. Provision is also made on the parcels opening empty bag despatch system to deliver bags direct from opening to the working area on the first floor if necessary. Eighteen inch conveyors are used throughout the empty bag system.

Electrical Control

The suburban bag despatch system is started from either the third or first floors from stop-start stations, with "run" indicator lamps. Similarly the country and overseas systems are started from stop-start stations located on the control panels of machines in the area which they serve. The empty bag conveyors start automatically when the appropriate opening machine is switched on. Similar emergency stop, interlock and fault indication facilities to those described in the inward bag system are provided.

CONCLUSION

In this article the authors have given a general description of the Bag Handling System in the Sydney Mail Exchange. Even though this system is the latest in Australia, improved methods of bag handling are constantly being studied by Post Office engineers. With the despatch of bags by keyboard operation, the way is opened for automatic bag checking and statistical recording. Progress may also be made in the near future on the standardisation of bag sizes, which will greatly assist in handling mails from overseas countries.

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other, although the electrical and mechanical design groups within each team needed close co-ordination.

As will be discussed in more detail later in this article, with little exception, the conventional equipment was manufactured and assembled by T.E.I. production divisions, whereas their attention to the Letter System was directed mainly at final assembly and adjustment of mechanical sub-assemblies. This was found necessary because of both the time factor and the need for special machinery skills and facilities to manufacture such highly toleranced and intricate piece parts and sub-assemblies. Needless to say the decision to subcontract such work culminated in a profound survey of the Australian light industry and ultimately involved manufacturers located in three States of the Commonwealth.

CONVENTIONAL MAIL HANDLING EQUIPMENT

The Design

During the whole of this project, whether conventional equipment or Letter Sorting equipment, time was never on the side of the constructor. Many unforeseen problems arose even in what at first semed to be straightforward areas.

Perhaps the greatest problem with the conventional equipment was the integration of established designs of parcel and other article sorting machines previously manufactured by T.E.I. into systems which would satisfy traffic requirements. Many calculations were required by designers to establish the speed and size of transfer and storage conveyors, the size of the mail bag opening glacis used with various systems and the number of machines required.

It is usual in mail handling design to take advantage of the cheapest force available, namely gravity, but this fact in itself brings many problems to the design engineer, such as the slope of the chute, the frictional forces, the need for specially designed pneumatic loaded baffles and so on, in order to ensure minimum risk of damage to matter contained in mails, particularly parcels. The heterogeneous nature of mail matter, the noise level generated by falling articles, mechanical diverters, moving belts and electric motors were also important considerations. Finally the ability to physically achieve the desired location of the various sorting machines, conveyors and chutes on site was found to create problems and the need for compromise.

Of no small significance was the question of mail transfer points, where a change from one transfer conveyor to another or from the conveyors to the machines was required. Each transfer point was found to produce its own particular problem, solution of which was essential if the systems were to function satisfactorily and efficiently. Finally the question of interlocked electrical controls was considered on a system basis, together with the use of indicating lamps and mimic diagrams to assist in the operation of the system.

Manufacture and Installation

On the manufacturing and installation side, perhaps the most important overall decisions surrounded the question of the necessary breakdown of chutes, conveyors, opening glacis, and sorting machines into sections or modules which could be shipped to site from the factory. The limitations of bulk and weight needed close attention by both designers and manufacturers in the light of the capacity of transport vehicles, elevators in the Sydney Mail Exchange and facilities available both in the factory and on site for material handling. For example, an Other Articles Sorting machine was broken down into three types of modular units namely, head, tail and bin units.

Modular or unit construction was used throughout all conventional systems and with the exception of chutes and straight conveyors, which presented little or no problem, it was found wise to pre-assemble the complete machine comprised of a number of modules in the factory, fit all panels, sub-assemblies and piece parts and subsequently break down into finished modules for transportation to site.

This technique guaranteed rapid installation progress and minimum effort by 'on site' installation staff whose facilities were extremely limited when compared with those of their colleagues in the factory.

The manufacture of this equipment was classed as short run production or jobbing work which necessitated the employment of skilled labour readily adaptable to such production techniques and not the process type labour used in long run production work, such as crossbar equipment manufacture. The classes of labour used can be summarised as fitters, welders, carpenters and machinists, who were required to use such machines as presses, guillotines, lathes and mills. Whilst certain jigs and gauges were necessary to assist with the manufacture, tooling was negligible and in fact was confined to the preparation of forms or moulds for the moulding of sections of the fibreglass spiral chutes used extensively throughout the installation.

Contrary to the procedures used in the manufacture of the Letter System which are discussed briefly below, normal company procedures were used during the manufacture of the conventional equipment. These can be summarised in the following steps:

(i) Design drawings were sent to the Drawing Office for detailing, during which dimensions, tolerances, finishes etc. were specified.

(ii) Detailed drawings were then returned to the design staff for checking.

(iii) The drawings were then issued to the Production Division crib with sufficient copies for distribution to Methods staff, Quality Control officers and Production supervisors.

(iv) The Production Division's methods staff or production planners prepared the methods layouts, initiated action for the purchase of 'in aid' parts or sub-contract work through the Purchasing Division and issued instructions for manufacture.

(v) On completion of manufacture and the necessary quality control inspections, modules of pre-assembled machines were sent to site for re-assembly as machines.

(vi) Completed machines were commissioned as an entity, then as part of their associated system.

(vii) Finally the A.P.O. tested the systems functionally using simulated mail.

Due to the time element it was not unusual to find production planners regularly requesting detailed drawings from the Engineering Division to maintain production flow. It became a 'hand to mouth' operation towards the end of this facet of the project. What might have seemed at times a minor alteration to the designer, could well have resulted in a major disturbance if it had not been for the maintenance of close co-operation and coordination between Engineering and Production Divisions.

For certain connecting chutes, it was not possible to prepare formal drawings, as the precise dimensions and tolerances could not be specified until the installation of certain conveyors and machines was well advanced. Accordingly these were designed and built on site under the direct supervision of design engineers.

The important manufacturing and installation problems encountered at various stages of the project, could be summed up as follows:

(i) Critical shortage of suitably qualified staff. This, of course, was recognised as a national problem and not just peculiar to T.E.I. Steps taken to relieve this situation included the use of sub-contract labour on site, which brought its own problems, and the importation of some fifty fitters from the United Kingdom on a six months contract basis.

(ii) Temporary storage of bulky items of manufactured equipment pending the completion of building space in the Sydney Mail Exchange. The A.P.O. assisted with this problem by finding suitable storage space in their stores buildings.

(iii) The requirement of large scale production of such bulky equipment brought space problems to the Company also, although additional factory floor area was allocated as successfully to the A.P.O., however, this was only the beginning as far as the abovementioned Divisions were concerned and much remained to be done. Nor was this the end, in fact, of the design activity for trials of these prototypes revealed the need for many mandatory design changes before it could be claimed that reliable and efficient machines could be manufactured. It was at this point in the project that the critical production eye was cast over the machines and many of the changes needed were associated with necessary production concessions.

In addition, design attention was still required to ancillary equipment such as storage and despatch consoles, stream feed units, the transfer system, gauging machines, separators, bundle and bulk tables and so on, and the general electromagnetic and electronic system controls.

PERT Analysis and Programming

Nevertheless, the most difficult design area had been identified and the important problems solved. The system was roughly cast in the minds of Production personnel and accordingly it was possible to form a complete PERT analysis of the whole project. Thus, during the next few months detailed enquiry was made through all Company Divisions concerned, lead times established for ordering component parts, production preparation, documentation for testing and so on, and all activities and events identified with the most probable, the most pessimistic and the most optimistic completion times required for each activity.

Final analysis by PERT method revealed a critical path which set the most likely completion date as September, 1967. As mentioned previously, however, the A.P.O. had extended the completion date from mid-1965 to mid-1966 and thus it became necessary to identify holding factors along the critical path, review, take action, reduce, identify the next critical path revealed and proceed through the same cycle of action.

Subsequently GANT type charts were prepared in which all main mechanical sub-assemblies of the coders and decoders were identified in addition to the ancillary equipment which was listed on a separate sheet in a similar way. Fig. 1 illustrates a small section of one such chart.

Target completion dates were programmed for each function executed by the various Divisions of the Company on each item of equipment, namely design, detail, methods analysis, purchasing, tooling, production, testing, quality inspection, installation for all sub-assemblies and machines concerned. The Production time scale for each was determined with a view to the logical flow of these items to the site for installation. For example, integrating channels were the first requirement, followed by coder tail units, coder frames, 30 channel conveyors and the various sub-assemblies of the coder. A similar procedure was followed in programming the manufacture of decoders and the ancillary equipment, that is, in accordance with the dictates of the installation programme.

This work was completed in March, 1965 and it was at this point in time that the full import of the magnitude of the task which lay ahead was first realised, particularly in the light of the completion date of mid-1966.

Formation, Composition and Operation of D.M.I. Committee

At this stage what proved to be the most significant organisational move of the whole project was initiated. It was agreed to form a steering committee or working party within the Company, which became known as the D.M.I. Committee, meaning design, manufacture, installation. Careful consideration was given to the composition of the Committee and it was finally determined that senior Company personnel should be included from Engineering, Methods, Production, Purchasing, and Quality Assurance Divisions. Fig. 2 shows a meeting in progress. It was the outstanding effort, tireless energy, courage and tenacity of the people of this Committee, which caused this major project to turn in the minds of men from a seemingly hopeless task in terms of the permitted time scale, to a reality with a most satisfactory end result.

The first meeting of the Committee was held in April of 1965 and regular fortnightly meetings were held to the end of July, 1966. The success of these meetings rested in the following factors:

(i) Every effort was made by Engineering representatives to clearly explain the function and define the main parts of each sub-assembly of each machine under discussion.

(ii) Every problem raised, no matter how small, was discussed freely until a clear line of action was determined and associated with a particular Committee representative or sub-committee for action.

(iii) Where 'short cuts' were found necessary which could breach Company Standing Procedures or Routine Instructions, approval was given provided all present were completely briefed on the 'modus operandi' proposed and the Committee agreed that a need existed for such action. In fact a special instruction was approved by top company management which detailed the role of design, production and purchasing personnel in dealing with sub-contractors employed on this system.

(iv) Committee members were specifically requested to highlight all delaying factors at each meeting and the reasons for delays were ascertained during the meeting, with all concerned making a special effort to be constructive and avoid perturbations.

(v) A shorthand minute secretary was employed and as much of the meeting proceedings recorded as was possible. Subsequently the Chairman

Fig. 2 — The D.M.1. Committee in Session. Going around the table from left to right: L. Shannon (Purchasing), L. Hulka (Mechanical Design), N. Dunn (Methods), O. Wirsu (Electrical Design), W. Fielder-Gill (Executive Engineer — Chairman), Mrs. A. MacDonald (Secretary), J. Marchant (Quality Assurance), R. Iveson (Electrical Production), R. Seguss (Mechanical Production) and T. Dean (Drafting).

first action taken in respect of each respondent was a preliminary examination of the type of work with which they had been previously engaged to assess both the quantity and quality levels of their labour and production machine tools, particularly in respect to capacity and suitability for the type of work required by the Letter System.

Naturally it was part and parcel of T.E.I.'s contract with the A.P.O. that their approval be given to the particular sub-contractors selected by the Company. It was also very much in T.E.I.'s interest that subcontractors chosen were reputable firms with a background of precision sheet metal and machining work of such magnitude to justify the employment of adequate Production Planning and Quality Control facilities. Hence, out of a total of some 50 New South Wales and interstate companies who were invited to tender for either the manufacture and assembly of complete units, or the supply of component parts for ultimate final assembly by T.E.I., some 12 firms only were determined as justifying closer examination.

Following a selection of these companies, a visit was made to their works by T.E.I. Production representatives of the D.M.I. Committee, to assess the following important aspects of their operations.

Management Outlook: It was obviously vital to the success of the project that the top management of any sub-contracting firm demonstrated their ability to provide sufficient incentive within their organisation to produce maximum effort on the work which would be allocated to them. This required a close assessment and proper judgment of the drive, initiative and imagination of the top company people particularly those concerned with the production areas. In each case a lengthy discussion with these people, particularly in relation to their past performance on other product lines, was the secret of success, identifying those areas where statements made could be proved with ease.

Type of Plant and Labour: As the majority of the work offered by T.E.I. to the subcontracting area was of a jobbing or short run production nature, particularly the milling and turning fields, observation was centred mainly on machines of suitable capacity to produce comparatively small components with a minimum of tooling, yet able to reproduce parts within drawing tolerances and short run production batching. The assessment of these requirements necessitated a close inspection of each company's production area together with an evaluation of the type of labour and skills employed. A careful examination of the standard product lines manufactured by these companies was of considerable assistance in determining the likely end result of their work on the sub-assemblies proposed for their attention.

Quality Control: As this project required production accuracy not normally found in general engineering production shops, but more closely allied to tool room standards, close attention was given to the organisation and capability of the Quality Control Division within each company visited. In addition, a detailed examination was made of their inspection facilities particularly in respect of the measuring, testing and gauging equipment available and the qualifications, outlook and standard of inspection staff employed.

Production Planning and Cost Control: During visits to these companies it was necessary also to examine their methods of cost control and their production planning organisations which would be used during all phases of their sub-contract work. Both these aspects were important, as T.E.I. needed assurance that their whole production organisation operated efficiently and at minimum cost, particularly as time did not permit the usual action of calling for at least three tenders or quotes from sub-contractors. It was generally the case that only one sub-contractor was approached and the order placed following satisfactory inspection of these aspects together with other factors mentioned above.

During initial T.E.I. production planning for all sub-contract work, decisions were necessary as to the piece parts which would be supplied by T.E.I. as "in aid" items to the subcontractors. This decision was important because it is often the case that a good purchasing organisation within a company can negotiate the supply of proprietary items at very good prices, and accordingly it was deemed advisable to keep the T.E.I. Purchasing Division in control of this situation. Accordingly, such items as castings, special ball bearings, certain types of electric motors and imported items were detected as parts for T.E.I. purchase action.

Another most important point which is monitored by a competent purchasing division is that of making doubly sure that these proprietary items are available at such a rate as to meet the program for the completion of sub-assemblies by sub-contractors or at the T.E.I. works.

Having placed the various sub-contracts and determined the "in aid" parts which would be supplied, T.E.I.'s responsibilities were far from ended. In fact, T.E.I.'s continuing responsibilities could be summed up as follows:

(i) Offer technical or purchasing assistance or alternatively take the initiative from the subcontractor in securing basic materials in short supply, e.g. special steels.
(ii) Maintain a continuing and roving inspection of those local sub-contractors who may not have completely come up to T.E.I.'s standards on Quality Control aspects.
(iii) Provide continuous liaison between sub-contractors particularly where different companies were producing the same or similar mechanical sub-assemblies.
(iv) Ensure that the sub-contractors concerned were supplied with latest engineering information and that the required number of raised issue drawings were made available as expeditiously as possible. It is worth noting that some engineering changes often necessitated a temporary cessation of production.
(v) At all times maintain close liaison between the sub-contractor and the T.E.I. Design Engineers, particularly with a view to testing the effect on both price and delivery of design changes categorised as desirable.
(vi) Constantly check various quotes submitted by sub-contractors for additional work or as a result of change orders against T.E.I. cost estimates for the same job. Particular attention was paid, of course, to any claims made by sub-contractors for extras which they considered above their commitment under the original contract.

Because of the pressure on T.E.I. Design areas, it was often the case that a detailed technical specification was not available to sub-contractors nor to T.E.I. Production Divisions. Accordingly, it was necessary to have Engineering Design personnel work in conjunction with Production Inspection Staff to inspect and function completed units as they were offered by the Production Line. This need proved of value to both T.E.I. Engineering Divisions and the subcontractors' production personnel as the Designer could explain personally the vital functional aspects of each sub-assembly. In addition, this personal contact placed the production of all further sub-assemblies on the best possible basis and assisted in the completion of the work by the prescribed delivery dates.

A further important decision related to those sub-assemblies which it was decided to produce within T.E.I. For obvious reasons the most difficult were kept within the Company's Production area where close liaison with the Design staff could be maintained at all times. Two factors assisted in the decision and these were:

(i) Those sub-assemblies which suffered a major redesign following tests on the prototype machine, and
(ii) Sub-assemblies or parts which had not been produced during developmental stages and obviously required the attention of experienced T.E.I. Design, Production and Quality Control personnel.

machine frames, were critical factors in the timing of the manufacture of the whole project. Naturally, the exact final shape of each cableform could not be determined until a completed sample of the associated mechanical assembly was available.

The final design of the cabling became in each case a matter of urgency, so that the necessary fixing holes, access holes, etc. could be added to the manufacturing drawings and the information fed back to the Production areas soon enough to minimise expensive reworking of piece parts. The fact that piece part manufacture and assembly was in some cases located as far as 1000 miles from Sydney aggravated this situation.

In addition to the wiring design problems described above, the manufacture of the wiring assemblies produced its share of difficulties. These again were a direct result of the short time schedule. Although information was available well in advance concerning the multipin connectors required and bulk ordering of wire was attended to well in advance, the rate at which the component and wire manufacturers could deliver controlled the rate at which the specially established cableform assembly shop of T.E.I. could proceed.

Machine Electrical Controls and Switchgear: The two fundamental principles of mail handling machinery, namely that mail cannot be permitted to be mutilated and that it must not be misdirected, require very close interlocking and control of the machinery. Thus, if a blockage occurs at any point, or if the timing sequence or control information is lost, the associated mechanisms must immediately be stopped. At the same time, the flow of mail to this area must be stopped or immediately diverted to temporary storage or reject positions.

These principles require comprehensive systems of photo-electric and mechanical sensors and of electrical power switchgear to control the various electric driving motors in each machine.

Again, the final detailed mechanical design of the electrical assemblies, to suit the space available became a late item in the overall program. Consequently the production time was very much compressed. This brought about various problems of rapid co-ordination between the design staff in Sydney and manufacturers in other States.

The control equipment was made up in the form of packaged assemblies, which were brought together in the machine frames on site at Redfern and interconnected within each machine by means of prefabricated cables.

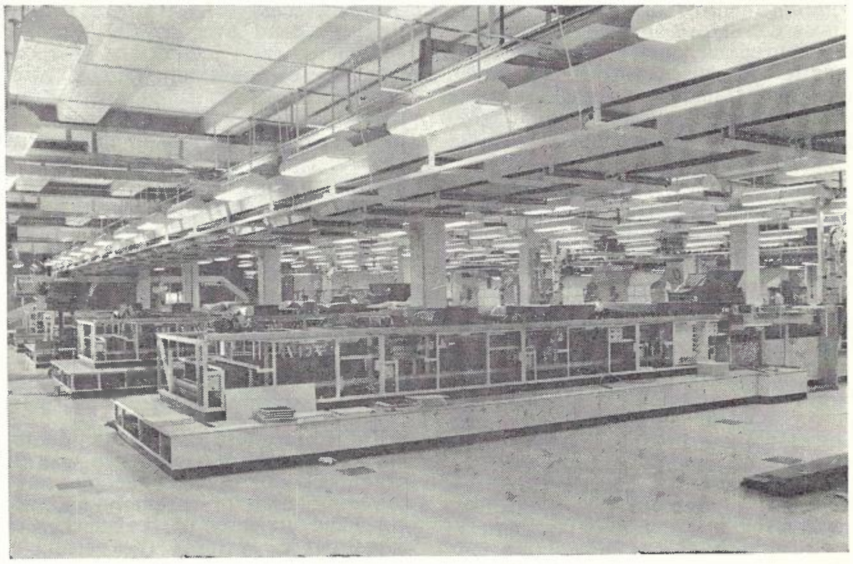

Fig. 4 — Suburban Decoders Being Installed on 3rd Floor.

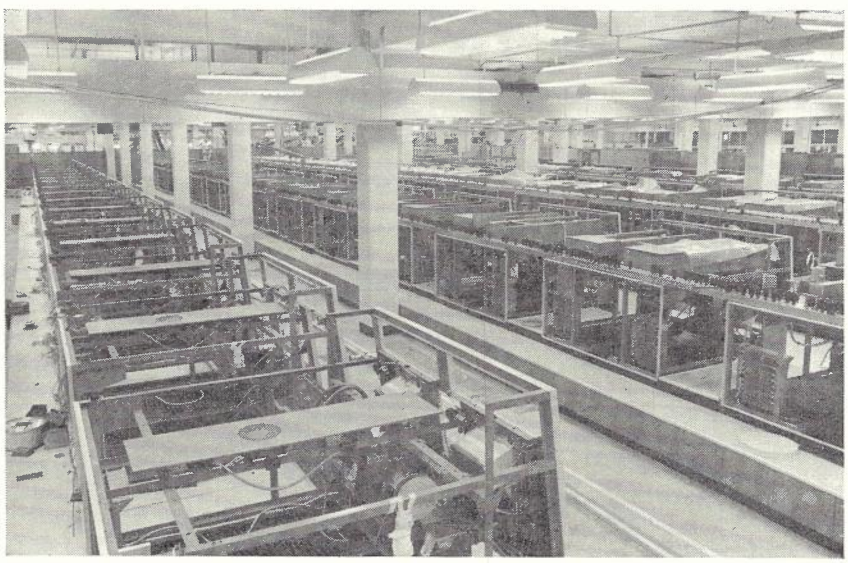

Fig. 3 — General View of Coders Being Installed on 4th Floor.

Installation and Commissioning

The installation in the Sydney Mail Exchange Building at Redfern contains 75 two-operator Coding Machines, 20 Decoding Machines, and a number of mail input and large capacity stacker machines, distributed over large areas and embracing four floors of the building.

Fig. 3 shows a general view of the fourth floor installation illustrating Coder suites in various stages of completion. Coder Suite 2 nearest camera is in earliest stage of all the four suites shown. Stream feed belting can be seen on rear of Coder Suites 5 and 4 farthest from camera. Fig. 4 is a view of four suburban Decoders on the third floor nearing completion. Each of these Decoders is equipped with three stacker-feeders with provision for a fourth.

All of the Coding Machines are located on the fourth floor of the building and each is connected by multiwire screened cables to the register/translator equipment and coding memory located in one corner of the fourth floor and by unscreened cables to the control equipment for the letter input system located near the centre of the same floor. Each machine has its individual three phase and single phase power feeders, and three separate feeders for direct current at 24 volts, from groups of common rectifier equipment.

Correspondingly, the Decoding Machines, which embrace the whole of the third floor of the building have individual three phase power feeders and direct current feeders as well as interlock and alarm circuits to the control centre on the fourth floor.

Also, the transfer system between the Coding Machines on the fourth floor and the Decoding Machines on the third floor, and the stackers on the second and upper ground floors, are connected by conveyor systems

THE SYDNEY MAIL EXCHANGE BUILDING

J. BELLETTE and C. McCARTHY, A.S.T.C., Dip.P.A., A.M.I.E.Aust.*

INTRODUCTION

To the Australian Post Office, and in particular to those vitally concerned with the study of mechanised mail handling the completion of this large and modern building project is much more than "just one of many modern building structures recently changing Sydney's skyline". It is the manifestation of the vision and co-ordinated effort of many Post Office people. To the planning groups, comprising officers from the State and Headquarters of the Australian Post Office and the Commonwealth Department of Works, the completion of this project is a fitting reward to the effort directed to the development of a project of such magnitude.

Perhaps the following facts and comparisons outlined in the form of statistics will create a mental picture of the structure and its functions prior to the more detailed analysis of some special features.

(i) Each of the floors in this building is 90,000 sq. ft. in area. This is equivalent to the total floor space contained in 75 average five-roomed homes.

(ii) Nearly two million bricks were used in the structure, enough to build about 150 brick veneer homes of average size; or if laid end to end would extend 280 miles.

(iii) 12,000 fluorescent tubes are required to provide the normal working light level and this in in addition to the natural light obtained from the 650 windows on the external walls.

(iv) A total length of 15 miles of steel piping is required to serve the fire sprinkler system, and this same quantity, if utilised to provide a normal water service and reticulation would provide service to about 650 dwellings.

(v) The building is planned to accommodate a staff complement of nearly 6000 by 1985.

(vi) It is estimated that within 20 years some six million postal articles — letters, newspapers, packets and parcels will pass through the Sydney Mail Exchange every day.

(vii) The staff cafeteria will be capable of serving about 4000 hot meals a day.

THE SITE

To those vitally concerned with the efficient handling of the Sydney mail traffic, it became evident many years ago, that the retention of the Mail Branch in the G.P.O., situated as it is in the Central City area, would create many problems as the population, business activity, and vehicular traffic density in Sydney continued to expand. A careful study of the population trends, the posting habits of the people, the increase in the incidence of mail articles per capita, and many other determining factors indicated a need to establish the mail activities in a centralised Mail Exchange by about 1965. This of course required a site of suitable size, capable of development by about 1960, and located near the Central City area with convenient access to the G.P.O., the rail terminal, and shipping and airport facilities. Following an extensive survey of suitable areas in and around the City zone, the site on which the Sydney Mail Exchange now stands was acquired in 1949. (See Fig. 1). The prerequisites for such a

* Mr. Bellette is Senior Buildings Officer, Works Programme and Buildings, Headquarters.

** Mr. McCarthy is Engineer Class 4, Buildings Services, N.S.W.

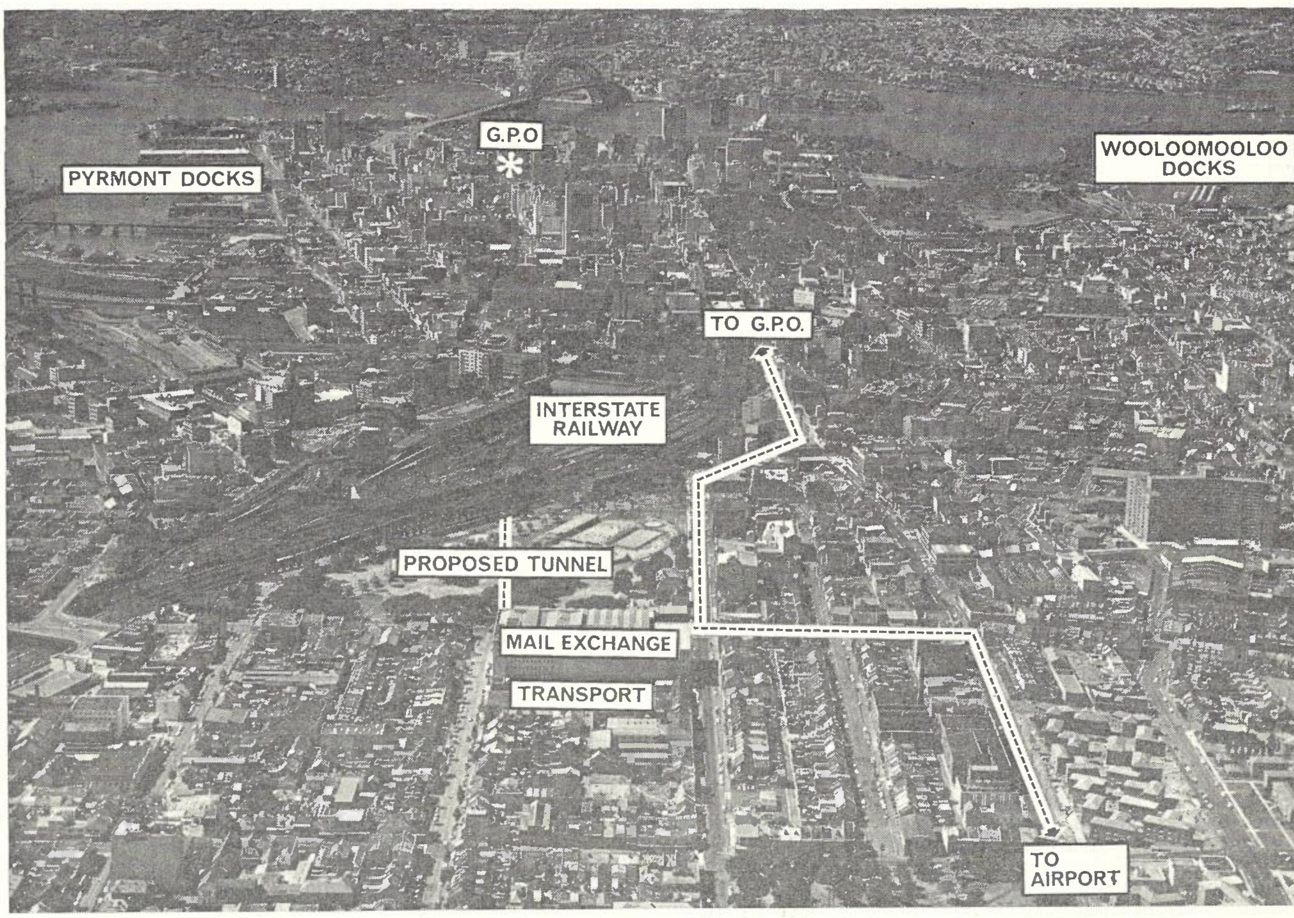

Fig. 1 — Aerial View Showing Location of the Building in Relation to G.P.O., Railway Terminal, Docks and Airport.

of the special features of the project, with emphasis on those functional aspects of the design vitally necessary to the setting up of the Exchange as it will finally operate.

STRUCTURAL FRAME

The structural frame was designed to contain the main mail processing floors from the lower ground to the fifth floor in a frame 400 ft. in length by 177 ft. in depth. The amenity areas, administrative accommodation, escalator vestibules and supervisory staff offices to be planned into a front section of the building projecting 73 ft. 3½ in. from the Cleveland Street facade and having a width of 278 ft.

As a low rise building was called for, reinforced concrete was chosen for economic reasons, and although the building is of considerable magnitude some 450 standard bays have been introduced which considerably reduced the construction time and formwork costs. Apart from the normal consideration of structural economy, a number of factors were taken into account when determining the column spacing, floor loading and permissible member sizes. It was found that a structural grid of 25 feet column spacing was most suitable, except for those bays directly above the vehicular driveways on the ground floor. In these bays the spacing was increased to 27 feet.

Considerable thought was given to the requirement for a number of large apertures in each of the floors to facilitate the passage of chutes, conveyors and letter transfer carriers from floor to floor. A monolithic system was therefore designed and reinforced in such a way as to permit the provision of specified apertures and at the same time some allowance was made for further apertures to be cut away to meet future requirements, without creating major structural problems.

At the design stage, consideration was given to the extensive duct systems required to distribute large volumes of conditioned air and a means of obviating the need to increase the floor to floor heights on each level to accommodate these large ducts. This was achieved by designing the main girders, to run across the width of the building. These girders each support a grid of secondary beams running longitudinally. The secondary beams are 16 inches less in depth than the main girders. Air conditioning ducts, the fire sprinkler reticulation, and the electrical wiring are all fitted under the secondary beam system and as a result of design, there are no service fixtures suspended lower than the underside of the main girders. (See Fig. 2). Longitudinal runs required in any of the service reticulations were carried through the main girders by means of cored holes provided in the beams at the time of construction.

All the overhead conveyor and transfer systems associated with the mechanised mail processing equipment have therefore been located in suitable positions without height restrictions due to any underfloor building service runs.

It was realised that the attachment of overhead equipment and service runs to the underside of floor slabs would present a major problem at the time of installation. Threaded metal ferrules, spaced 3 ft. apart in both directions, were therefore incorporated at the time of forming the concrete floor slabs and so permanent fixtures are available at all times for the attachment of suspension droppers or steel sections. In addition to this facility, a great many small plugs have been incorporated in the concrete floors, which can be easily located and knocked through as required to permit the passage of electrical, telephone and/or other small cables through any floor, as and when required.

The structure provides a total floor space of 660,000 sq. ft. As the type of equipment to be installed is of relatively light construction and taking into account the estimated static and live loads associated with the mail handling activities, a design floor load of 100 lb. per sq. ft. was specified. This feature when combined with comparatively low ceiling heights of 11 ft. introduced considerable savings in the cubic contents of the project.

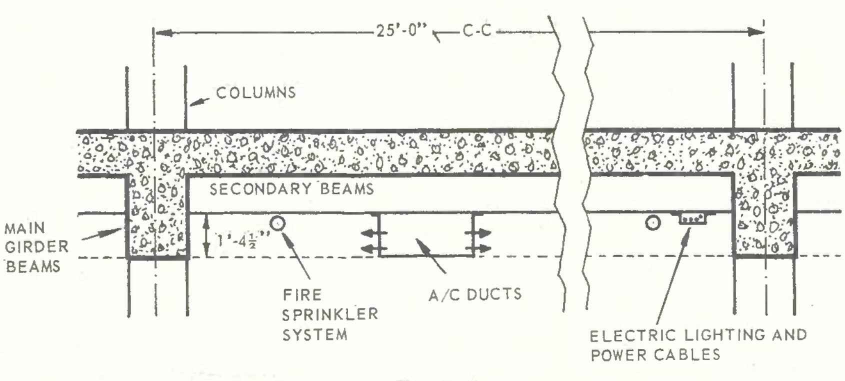

Fig. 2.

Thus economy was achieved not only in the ultimate building costs but to the design capacity and running costs of the air-treatment plant. In the design, consideration was given to the need to extend the building to the rear at some future date, and special provision was made to facilitate easy and economical extensions when required.

DESIGN FEATURES AND FINISHES

The semi-industrial functions within the building have influenced the economic approach to the structure and treatment of the elevations. The reinforced concrete frame is faced with selected brickwork which will combine the desirable qualities of durability, thermal stability, colour and texture. Aluminium framed windows, having pivot arrangements for ease of cleaning, have been used in the main fenestrations. These are set into precast concrete frames incorporating sun protection hoods at the head and side.

A cantilever arcade on the Cleveland Street frontage provides a covered way for staff approaching the main entrance vestibule from both Chalmers and Pitt Streets, and in conjunction with durable and colourful material finishes emphasises the main entrance and the Post Office in a dramatic way. The facades to the centrally located main entrance facing Cleveland Street have been treated with a blending of granite, travertine, aluminium and armour-plate glass.

The choice of internal finishes has been influenced by economy commensurate with the functional requirements but combined with the need to minimise maintenance and cleaning costs throughout the life of the building. In the mail processing areas granolithic finished floors are covered entirely with flexible vinyl tiles of a suitable colour blend. This type of floor finish assists in reducing noise from foot traffic and the passage of wheelers and other mail handling mobile equipment. The vinyl tile treatment has been carried up the walls to a height of 6 ft. The ceilings and walls above the dado height are finished in off-form concrete and/or cement render. Light reflective colours have been applied to these areas as a plastic finish.

In the amenity areas, the use of high quality ceramic tiles has been included for the purpose of maintaining hygiene and to cut down cleaning costs. All fittings other than pedestal pans are of stainless steel. In several areas, where large staffs will be using the ablution facilities, stainless steel fountains are installed, located in such a way as to allow for many persons

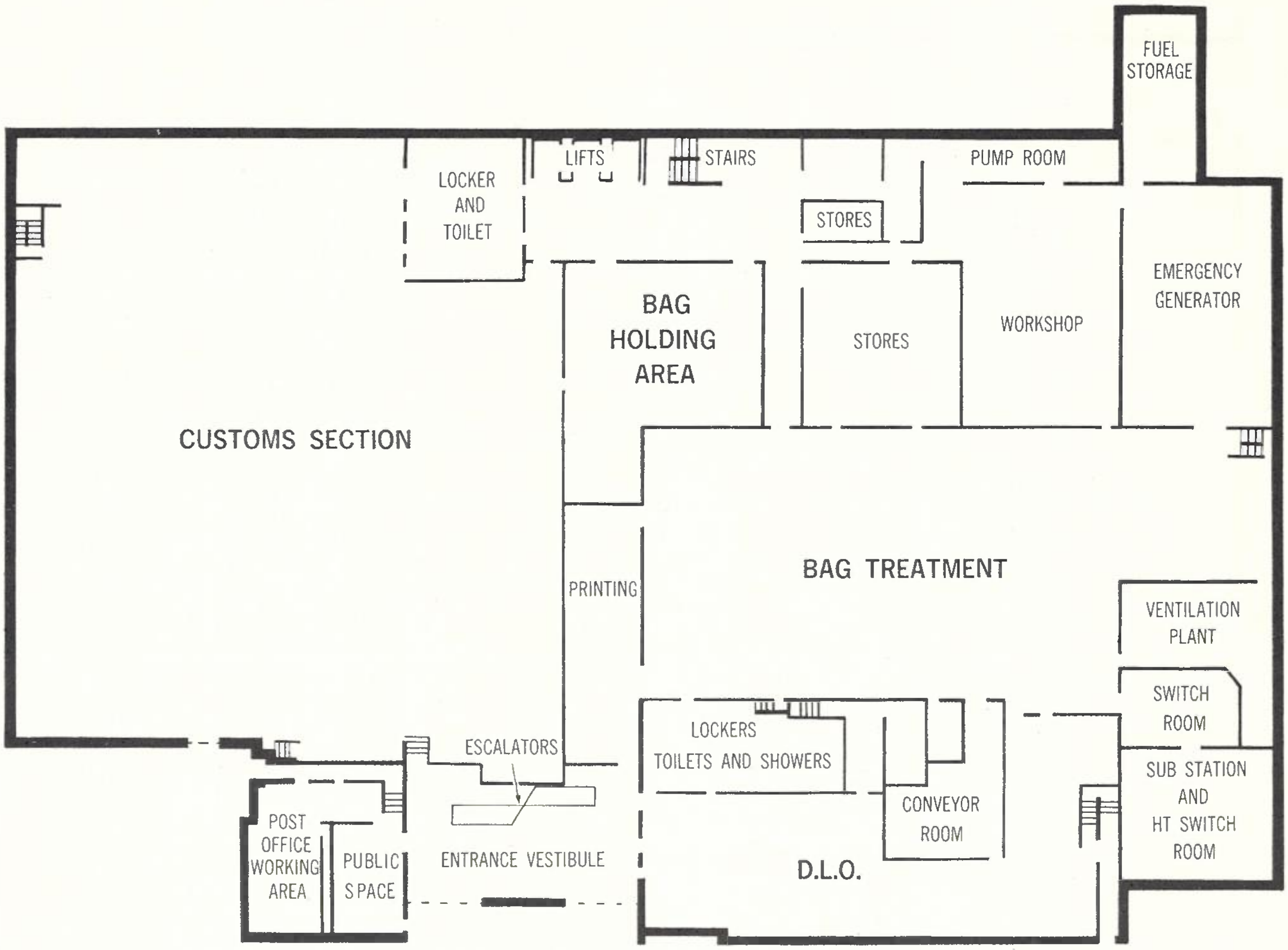

Fig. 4 — Lower Ground Floor Layout.

Customs Agents dock located at the rear of the ground floor have been installed as additional features.

On this lower floor level, the electric sub-station is located below ground level and distribution of the main power supply throughout the building is arranged from an adjacent switch room. Emergency plant equipment is also conveniently located in this area. The balance of the space has been allotted to a mail bag storage and treatment section, maintenance technicians' workshops, carpenters' shop and the amenities for the total staff required to operate the activities on this floor.

The Upper Ground Floor

The upper ground floor has been planned to facilitate the receipt and despatch of all mail matter by motor vehicles. The main docks and traffic lanes provide drive-through facilities between Pitt and Chalmers Streets, thus permitting a direct flow of vehicles entering and leaving the building. (See Fig. 5.)

The vehicle docking system has space for 60 standing vehicles at any one time and the width between the docks allows space for vehicles to drive through between vehicles standing at the receipt or despatch platforms. Loading platforms rise 3 ft. 6 in. above the driveway level. The two outside platforms are used for receipt of incoming bagged mail and parcels for processing and the central dock is utilised entirely for despatch of outgoing mail. Bagged mail for despatch is delivered to the despatch platform by a bag conveyor and a glacis system.

The receipt docks are fitted with under-floor bag conveyors. Bags from vehicles can be placed on these conveyors through appropriately spaced apertures in the dock floors or from side apertures located in the risers, and by this means are conveyed to a vertical bag conveyor located at one end of the dock whereby the incoming mail is lifted to the mail opening positions on the fourth floor.

Due to the concentration of exhaust fumes from many standing vehicles, a special ventilation system has been installed. The intake registers are located in the face of the dock risers at a height calculated to draw the fumes from vehicles close to the level of exhaust.

On the Cleveland Street frontage of this dock level, portion of the Administrative Section is accommodated and toilet and amenity blocks have been conveniently located in the balance of the area. As many drivers of vehicles may be congregated in this area throughout the day, a kiosk and food service centre has been provided.

First, Second, Third and Fourth Floors

The first floor is mainly set up for the secondary and final sorting of the parcels traffic. The front block contains the staff amenities and a section is divided off to provide suitable accommodation for managerial staff.

At the eastern end, two of the ancillary areas mentioned previously have been accommodated, partitioned off from the open working space. The ancillary services are the Canvas Workers and the Labels and Wrappers Section.

The second, third and fourth floors are similar in layout to the first floor change of clothes, for any who may wish to remain in the city to attend evening or night functions. Some of the major aspects to be considered in planning the amenities areas were the provision of facilities for the maximum staff including the estimated increase during the busy pre-Christmas periods, the relation of staff to the roster system around the clock, and the need to consider the possibility of changes in the ratio of male and female employees during the life of the building.

The extent of lockers has therefore been provided on the basis that all staff, whether normal or pre-Christmas should have a locker available for allocation whilst that person remains an employee. These locker rooms have been planned as large open areas with a number of entrances so that a subdivision can be made at any time should the ratio of male to female numbers change.

Toilet and ablution facilities were planned to meet the requirements for the maximum number required to be on duty at any one time. The toilet ablution blocks, and shower facilities have also been designed for easy changeover from male to female if circumstances demand.

The cafeteria has been designed and equipped to serve hot meals for 1200 persons during any one meal break. The food services have been located on the top floor for many reasons. (See Fig. 6.) In the first instance the greater concentration of operative staff is located on the upper floors and as the meal breaks are in the main of only about 30-45 minutes duration, little time is lost in proceeding from the operating position to the cafeteria. It was also considered desirable to divorce meal facilities as far as practicable from the normal mail activities, and so provide a psychological relief from everyday working environment. The location as a pent house also permitted the addition of a promenade deck of large expanse for staff to enjoy natural light and sunshine coupled with a fine panorama of the city and harbour.

As the whole of the working areas are fully air-conditioned, the cafeteria-lunch room is likewise treated. This obviates the need for staff to experience any change in temperature conditions during meal breaks, irrespective of seasonal temperatures. Adjacent to and opening from the cafeteria-lunch room are the facilities provided by the Australian Postal Institute for staff welfare and recreation. Library, billiards, table tennis, reading and study rooms are available.

For those employees not wishing to take advantage of meals available from the cafeteria, tea and coffee-making facilities have been installed. Boiling water is available at all times at many points and ample provision made for the washing and drying of utensils and crockery. A similar set up is available on the first floor in the Administrative Section.

For the mid-morning, afternoon and evening tea breaks, a trolley service operates on all floors and the trolleys travel to each operator at working positions. Specially equipped rooms are located adjacent to the goods lift on each level. These are fitted with refrigerators and dish washing facilities for use by the trolley service.

BUILDINGS ENGINEERING SERVICES

Air Conditioning and Ventilation

Because of the high internal heat load of the building all main working areas have been fully air conditioned where possible. The heat load is due to operation of mail handling machin-

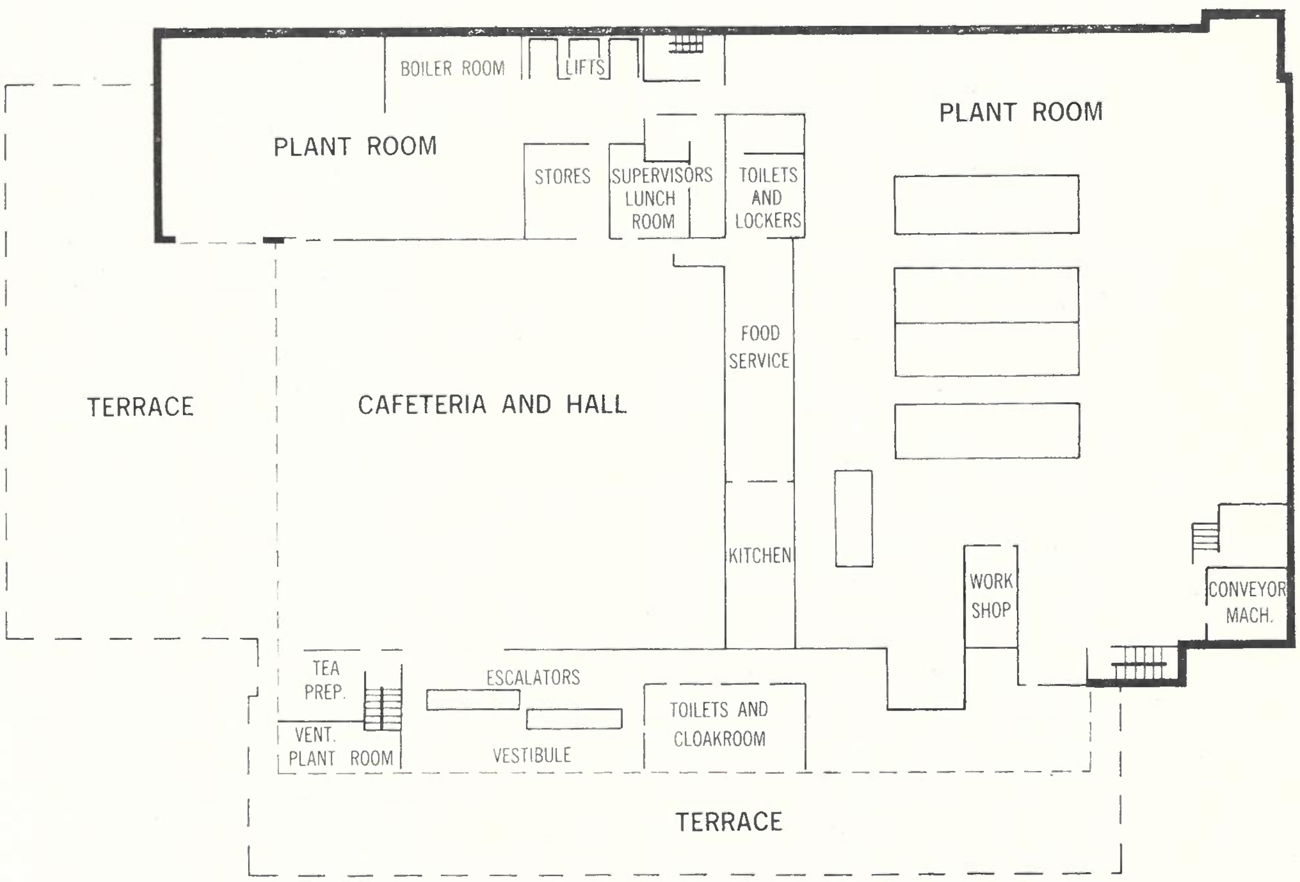

Fig. 7 — Top Floor Layout.

W. FIELDER-GILL

L. R. HULKA

O. L. WIRSU

D. Y. McFADDEN

Mail Exchange Project, which ranks as one of the largest of its kind in the world. Mr. Magnusson has represented the Department on several overseas missions and is regarded as one of the leaders in his particular field. He is a Senior Member of the Institution of Radio and Electronic Engineers (Australia).

★

W. FIELDER-GILL, co-author of the article "Sydney Mail Exchange — Co-ordination of Design, Manufacture and Installation," joined the Australian Post Office in 1941 as a Cadet Draftsman, and was promoted to Cadet Engineer in 1942 whilst on service with the R.A.A.F. as a Radar Officer. On discharge from the R.A.A.F. he completed the degree of Bachelor of Science (Physics) at the Sydney University in 1948 and qualified as an engineer in 1950. In 1952 he was promoted as Divisional Engineer, Lismore, subsequently transferred in 1955 to Canberra as Divisional Engineer, and in 1959 was promoted as Supervising Engineer, Metropolitan Equipment Service.

In 1963 he was appointed Executive Engineer, Telephone and Electrical Industries Pty. Ltd., a member Company of Plessey Pacific Pty. Ltd., Australia, where he was actively concerned with the Sydney Mail Exchange amongst his many other company duties in this capacity. In April, 1965, he was nominated as the Company Project Executive for the Letter System installation and as such chaired the company operated DMI Committee formed to co-ordinate the design, manufacture and installation activities of this project. In September, 1966, he was promoted to Plessey Pacific Pty. Ltd., Headquarters, in Sydney, as Management Development Executive.

★

L. R. HULKA, co-author of the article, "The Letter Handling System," was born and educated in Czechoslovakia where he graduated in Mechanical Engineering at the Prague University in 1949. He immigrated to Australia early in 1951 and, after fulfilment of two years contract with the Commonwealth Government, was employed as an operational Engineer on the Munyang Power Station and Gutega Dam by Selmer Engineering Pty. Ltd., a contractor to the Snowy Mountains Hydro Electric Authority. He was later employed by Australian Iron and Steel as a Mechanical Design Group Leader, and subsequently as Assistant Manager and Chief Mechanical Engineer to Transfield Pty. Ltd. on the installation of a Power Station in Cairns, Queensland.

He joined Telephone and Electrical Industries Pty. Ltd. in October 1962 as a Mechanical Design Engineer, Section Leader. In 1964 he was promoted to Group Leader, Mechanical Design, and in 1965 as Project Manager in charge of the Letter System Installation at Redfern. From the inception of the Letter System project he has ably led the Mechanical Design team and worked closely in conjunction with the APO Engineers concerned. He visited various countries, studying their approach to automatic letter sorting, during the progress of the project.

★

O. L. WIRSU, co-author of the article, "Sydney Mail Exchange — Co-ordination of Design, Manufacture and Installation", graduated Bachelor of Science and Bachelor of Engineering from the University of Sydney. He joined the Radiophysics Division of the C.S.I.R.O. in 1942, where he was engaged on the development of radar systems until 1946. He was then employed by Australian National Airways Pty. Ltd. and, as Communications Superintendent, was responsible for telephone and telegraph communications and airborne navigation and communications systems. In 1948 he joined the Radio Transmission Division of Standard Telephones and Cables Pty. Ltd., becoming Senior Engineer responsible for LF and HF Radio Systems, and Commercial Manager. In 1962 he became Chief Engineer of Westrex Australia Pty. Ltd., and in 1965 joined Telephone and Electrical Industries Pty. Ltd., where he is now Manager of the Design and Specifications Division.

★

D. Y. McFADDEN, co-author of the articles "The Bag Handling System," and "The Letter Handling System," completed an Engineering Diploma in 1951, and was appointed Engineer Grade 1 in the Department of Civil Aviation, where he was associated with the design of control tower equipment. He joined the Postmaster-General's Department in 1954 as a Group Engineer in the Telegraph Equipment Section, C.O., and worked on the design of equipment for the Telex network. In 1959 he was promoted to the Planning and Development Branch of the Postal Services Division as Senior Engineer, where he was engaged on the design of mail handling equipment.

In 1962 as Divisional Engineer, he was appointed Project Engineer for the Redfern installation. In this capacity he has been intimately connected with the design, development and installation of all the equipment in Redfern. In 1963 he visited the U.S.A. in connection with the purchase of machines for automatic facing and cancelling of letters and whilst in America took the opportunity to investigate experience in the solution of mail handling problems in Canada.

He served with Mr. Magnusson as Post Office representative on the Design Committee for the Sydney Mail Exchange. Mr. McFadden is a Member, Institution of Radio and Electronic Engineers (Australia) and an Associate Member, Institution of Engineers, Australia.

E. WULFF

E. WULFF, co-author of the article, "The Letter Handling System," was educated at St. Aloysius College, Milsons Point, and completed his degree in Electrical Engineering at the University of New South Wales in March, 1961. Following graduation he joined the laboratory staff of Telephone and Electrical Industries Pty. Ltd. as a Design Engineer and directed his efforts to the development of electronic and electromechanical switching circuits for various applications. In 1964 he was appointed Section Leader of the Electronic Design Section concerned with the design of electronic controls and the Register Translator equipment associated with the Letter System. He later supervised the documentation work necessary for production of this equipment introducing some novel concepts. In 1966 he joined the Installation staff on site at Redfern where he was responsible for the commissioning of the Register Translator and Coding Machine electronics. During the progress of the project he spent some months in the U.K. with A.T.E., Liverpool, a Plessey Company, studying magnetic drum techniques and peripheral circuitry designs.

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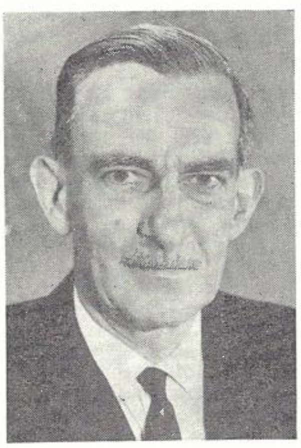
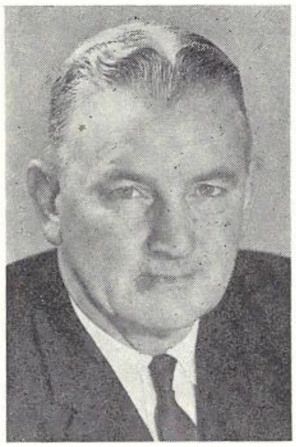


J. H. BARNES



W. R. COGHILL

W. R. COGHILL, co-author of the article, "The Other Article System," was employed in the Victorian Railways from 1932 to 1948 with the exception of a period of $3\frac{1}{2}$ years war service with the A.I.F. Corps of Australian Electrical and Mechanical Engineers. Whilst with the Victorian Railways he gained a Diploma in Mechanical Engineering at the Royal Melbourne Technical College under a railways studentship. Mr. Coghill joined the Postmaster-General's Department in 1946 as a Draftsman in the Headquarters Drafting Section and after some 2 years on design and preparation of drawings for telegram and mail handling equipment, was appointed as Engineer in the Headquarters Buildings Branch on electrical and mechanical buildings services. In 1952 he was appointed Group Engineer in the Buildings Branch, Victoria, where he was in charge of Buildings Service Centre staff engaged on maintenance of all electrical and mechanical buildings services including mail handling and postal plant.

In 1958 he returned to the Buildings Branch, Headquarters (now part of the Services Branch, Engineering Works Division) as an Engineer Class 3 where he has been associated with the installation and maintenance of mail handling plant and buildings engineering services. Mr. Coghill is an Associate Member of the Institution of Engineers, Australia.

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J. H. BARNES, co-author of the article "The Other Article System," joined the Postmaster-General's Department in 1941 as a draftsman with the Central Staff. In 1947 he was appointed Engineer on the design and development of mail handling equipment. Mr. Barnes was transferred to the Postal Services Division in 1955 when the Planning and Development Branch was formed to take over the planning and design of equipment for mail exchanges. He is now Engineer Class 3 in charge of the Equipment Design Section and has been associated with all recent major mail exchange projects.

A. H. BADDELEY

A. H. BADDELEY, co-author of the article, "The Parcels System," is Engineer Class 3, Design (Mechanical and Electrical) in the P.M.G. Research Laboratories. He obtained a Bachelor of Mechanical Engineering Degree in the University of Melbourne in 1944 and worked as a design draftsman in private industry for a year before returning to the University to complete studies for a Bachelor of Electrical Engineering Degree.

He entered the Postmaster-General's Department in 1947 and has been employed since then in the Research Laboratories on a wide range of design projects. In 1961, Mr. Baddeley obtained six months' leave from the Department to enable him to accept a French A.S.T.E.F. Scholarship, under which he studied electronic equipment design and construction in several manufacturing and research establishments in Paris.

★

R. L. SEGUSS, co-author of the article "Sydney Mail Exchange — Coordination of Design, Manufacture and Installation," joined the production staff of Telephone and Electrical Industries Pty. Ltd. in 1947. Initially he was engaged in the manufacture of

R. L. SEGUSS

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3.	October	1966	197-287

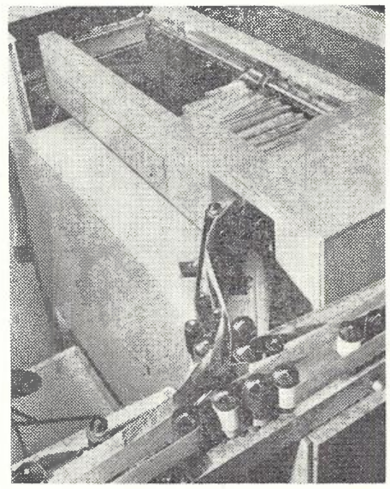
REFERENCE

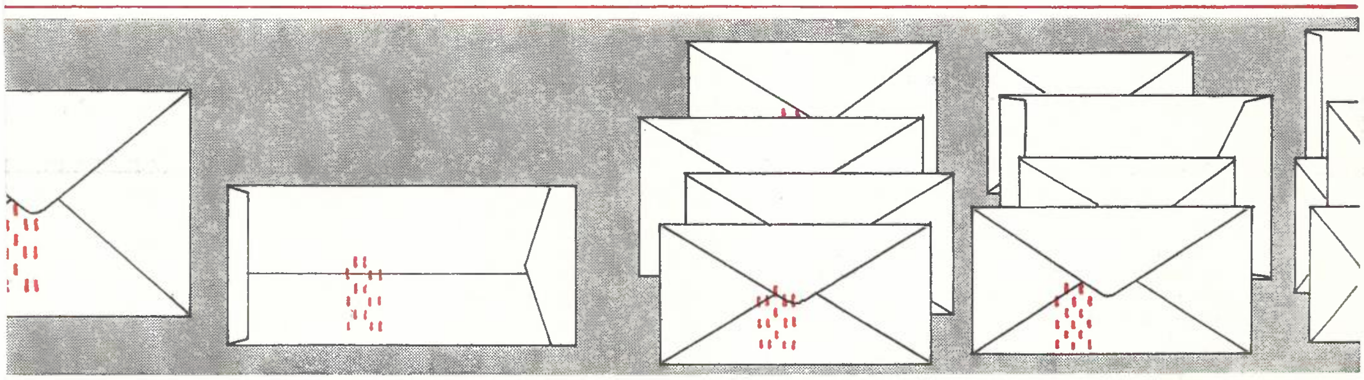
(T.N.I. refers to a Technical News Item of a Letter to the Editors)

Answers to Examination Questions

ng the suites of coding ines prior to commission-

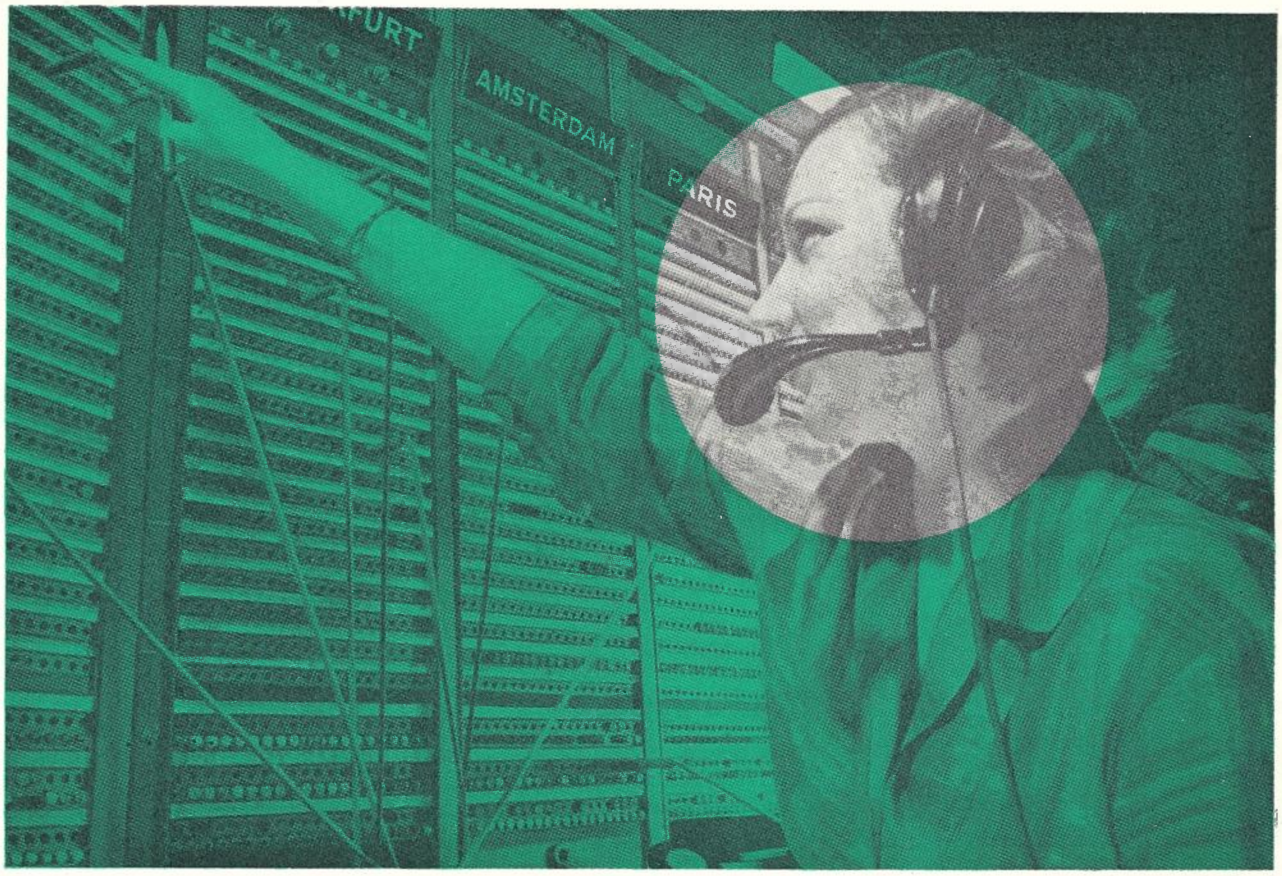
Unsorted mail is conveyed at 600 ft. per minute to the storage stackers located above each operator's position. The stackers are replenished automatically to ensure continuity of operation.



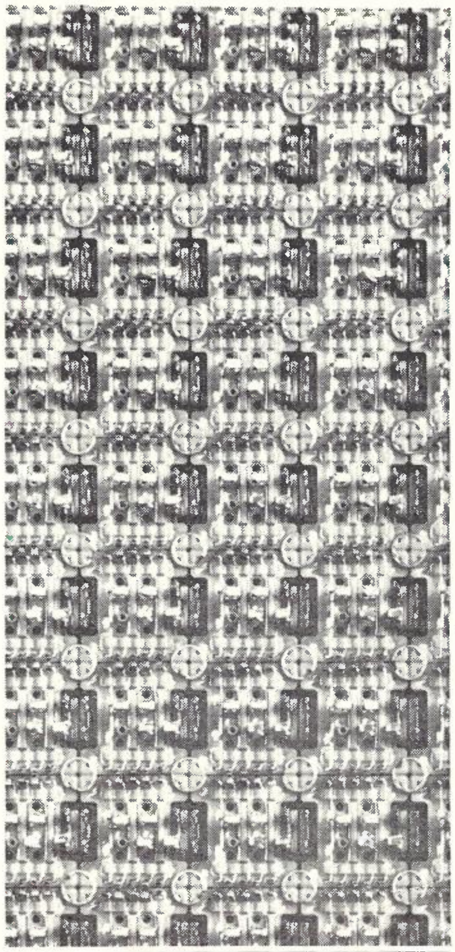


The first working model was tested in 1964 and the entire installation, comprising 150 operators' coding positions, 20 decoding machines and associated transfer conveyors, was completed for commissioning in 1966.

The simple step-by-step break-up in separate stages, each of 30 separations, gives maximum flexibility of equipment layout and greatly simplifies the mechanical problems associated with automatic letter-sorting to a large number of destinations.


AMSTERDAM
PARIS

SOPHISTICATED ELECTRONICS— BUILDING BLOCK SIMPLICITY!



The REX switching element

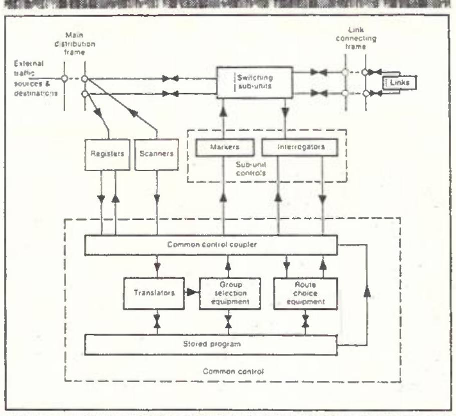
The basis of the REX system is the reed-relay switching element. It contains only nine different piece parts, compared with 200 in a bi-motional selector, and its very simplicity makes it uniquely reliable. There's nothing to wear out and it is sealed completely against dust and atmospheric pollution.

The REX switching matrix

Switching matrices can be built up in any form simply by clipping reed-relay crosspoints together. Thus unlimited provision for the growth of lines and links is built into the REX system.

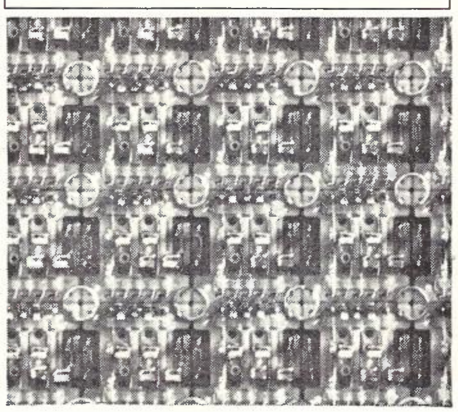
The REX switching unit

Basic switching arrays are built up out of matrices and are arranged in parallel to form a REX switching unit. Typically, a 1,000-line four-section unit would serve a community with an average calling rate of 150 call seconds per line in the busy hour; other calling rates can be accommodated by varying the number of sections.



The multi-unit REX exchange

Switching and linking arrangements are provided for all sections of each unit so that complete crosspoint path interconnection is made between all lines of the REX exchange. The special linking pattern adopted can cater for all traffic patterns whilst retaining simplicity of control.



REX electronic control

The REX electronic control has three main areas of activity:

Scanners and Registers: To determine the source and final destination of a call.

Markers and Interrogators: Concerned with interrogating the state of crosspoint paths and marking these paths through the switching sub-units.

Common Control: Processes the necessary call setting data in accordance with instruction from the stored programme control so that the calls are routed with maximum utilisation of the switching networks.

Information for administrations

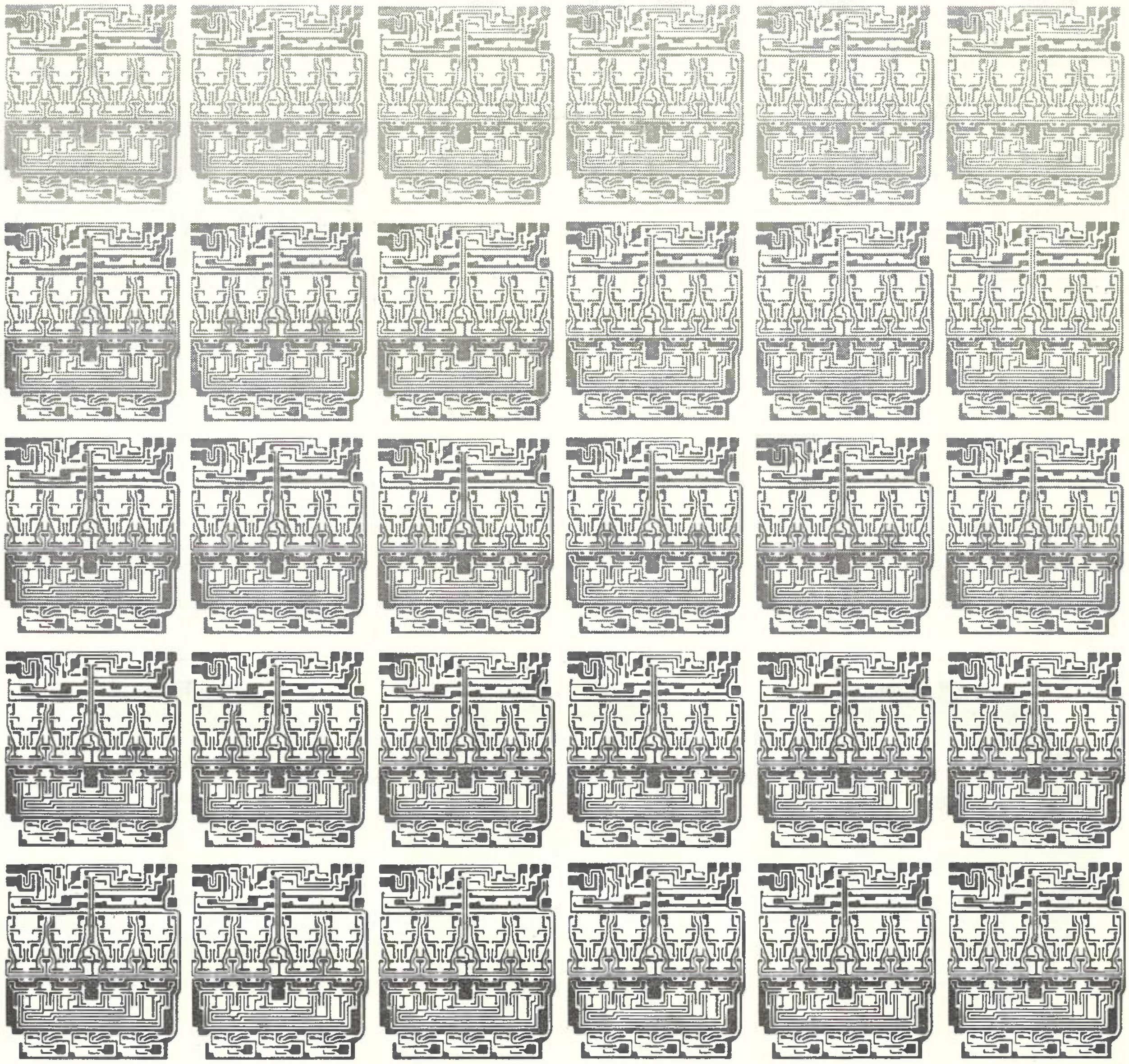
The AEI REX Information Service is one of the most comprehensive programmes ever offered. In addition to brochures and full technical data, AEI will gladly arrange for their lecture team to visit the engineering staff of interested administrations to provide an introductory course on basic REX principles. Later, key personnel would receive full training both at AEI's UK factories and on-site during installation. Training schools staffed and maintained by AEI are also under consideration for territories where reed electronic exchanges are proposed as standard.

Please write for full details

Public Telephone Systems
Department (Electronic)
Telecommunications Group
Associated Electrical Industries Limited
Woolwich, London SE18.
Tel: Woolwich 2020

REX is a UK registered trade mark.

AEI
TELECOMMUNICATIONS



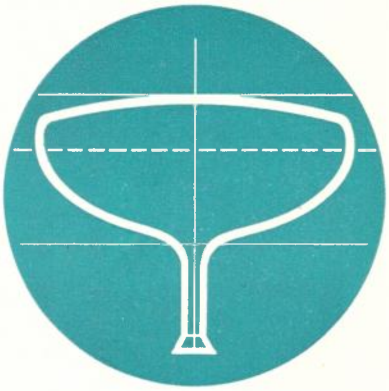
Corning Fluidic Devices
Fluidic devices, developed by Corning, bring to hydraulic and pneumatic systems refinements which were previously available only in electronics systems–logic functions, sensing, amplifiers, etc. Corning can supply both digital fluidic devices (such as gates

and flip-flops), and analogue devices in which the output varies directly with the input in terms of pressure and flow conditions. These devices are made with Fotoceram, a Corning ceramic material, which allows the necessary dimensional accuracy to be attained in a high-strength, solvent-resistant, wide temperature-range material.
Corning can supply these components:– Amplifiers, OR/NOR Gates, AND Gates, Flip-Flops, Binary Counters, Schmitt Triggers, Timers, Resistors, and Pressure-to-electric switches. You can make up complete fluidic systems from these components, or Corning can produce the complete system as an integrated circuit in a single Fotoceram block.

Corning Delay Lines
Our ultrasonic delay lines are made either with low-loss fused silica or zero-temperature-coefficient glass. Corning "Glass Memories", our high-speed delay lines for digital storage, offer * Storage up to 25000 bits (RZ) * Bit rates from 1 to 50 Mb/s at aver-

age access times 0.5 to 500 microseconds. * Low signal loss.
Corning also can supply non-digital delay lines for radar, colour T.V., and other analogue storage applications. These can be supplied for CW and pulsed CW operation at frequencies from 1 to 60 MHz, and delay times from 1 to 5000 microseconds.

Corning Materials for Electronics
Corning Glass Works is the largest producer of technical and specialty glass in the world, and has long been established as a major supplier of glass for electronic applications. Our Liverpool, N.S.W., plant has made bulbs for the picture tube industry in



Australia for several years.
Among the materials we supply are:– *T.V. Picture Tube Envelopes. *Valve envelopes. *Tubing and Cane. *'Multiform' and 'Clearform' beads. *Ground and Screened glasses. *Getters. * Microcircuit substrates and packages. *Fibre optics.
Corning's booklets "Engineering with Glass" and "Electrical Properties of Glasses and Ceramics" could be useful to you. They are available on application.

ECE REMOTE TESTING SYSTEMS
Automatically Reduce Maintenance Costs

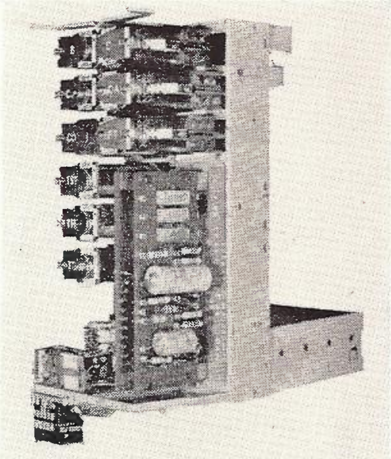
All standard line and equipment tests can now be carried out remotely by systems developed by E.C.E. for the Postmaster-General's Department.

For Metropolitan Exchange networks there is a centralised data transmission system which automatically operates testing circuits at distant Exchanges. For Rural Automatic Exchanges there is an automatic diagnostic tester which can be connected from the Exchange to the required line by dialling.

Both systems greatly reduce the problems of cost and availability of maintenance staff by making testing as fully automatic as practicable. The systems soon pay for themselves in reduced costs and, in addition, they improve efficiency and reliability of the telephone system.

The advanced design concepts used in the Metropolitan Exchange system have been partly derived from the Company's related activities in the design and manufacture of other TELSCAN systems. These are sophisticated digital systems for remote supervisory control and telemetry of utilities and industrial plant as well as remote exchange testing.

The latest techniques have been applied by engineering staff widely experienced in telephone systems, and this has made available modern and comprehensive test systems and equipment.



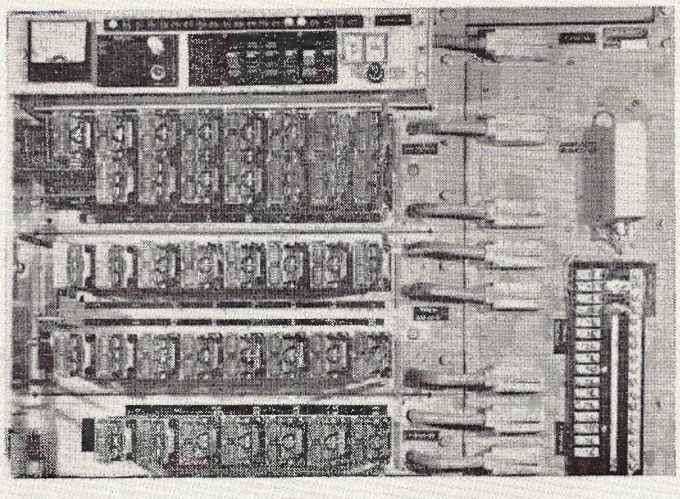
E.C.E. RAX Test Set

Remote Exchange Testing System

The E.C.E. system of Remote Exchange testing for Metropolitan areas enables comprehensive substation and subscribers' line tests to be carried out throughout each Automatic Exchange area from a Test Desk normally situated at a large Exchange in the area.

The efficiency of this centralised test scheme is achieved by the use of E.C.E.'s versatile TELSCAN digital data transfer system.

Completely centralised Metropolitan remote testing systems are now possible in rapidly expanding Metropolitan Exchange networks.



Remote Exchange Testing Equipment showing **TELSCAN** Relay Sets

Rural Exchange Test Set

This automatic test set for RAX use has been designed and produced by E.C.E. to enable Engineering staff to remotely test RAX exclusive and two-party subscribers' lines in rural automatic exchanges. It may also be used in conventional automatic exchanges where special access is available to the final selector.

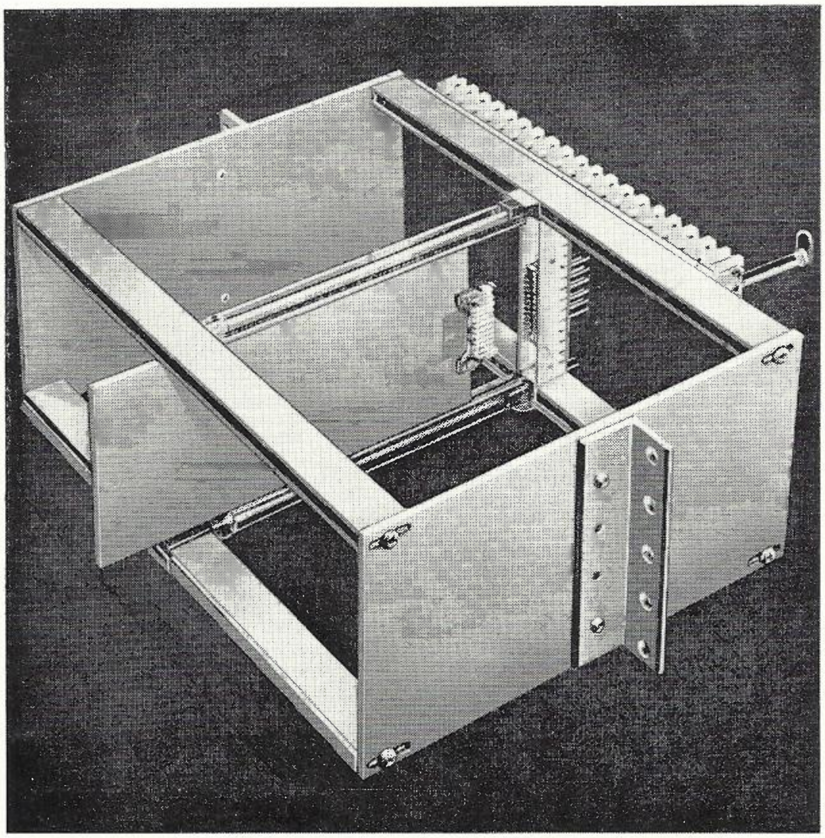
An automatic test cycle is initiated when the Testing Officer dials the test level followed by the subscriber's number. Then test pulses of 1500 c.p.s. tone will be heard at three-second intervals, allowing time for identification and recording on a check list.

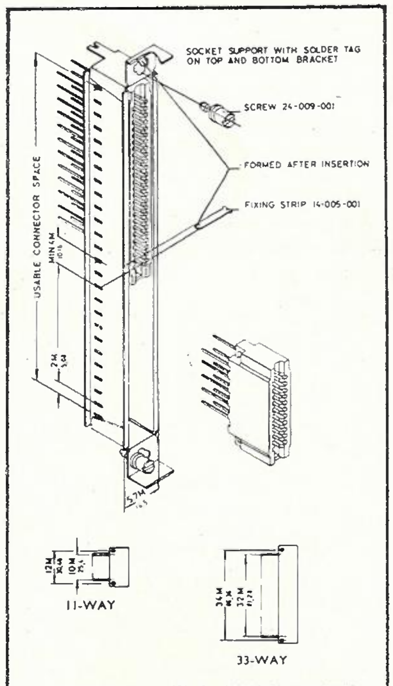
Pulse Length Monitor

The E.C.E. Pulse Length Monitor uses solid-state electronic timing circuits to check the length of make and break pulses on subscriber telephone dials more accurately than the conventional impulse speed, weight and counts tests.

The Pulse Length Monitor is incorporated in the E.C.E. Remote Exchange Testing equipment and is also available as a separate item for local exchange use.

ELECTRIC CONTROL & ENGINEERING LTD.
SYDNEY AUSTRALIA





(1) A 'socket support complete' consists of a 'socket support' plus two captive screws, to be ordered separately.
(2) See table of connector combinations.

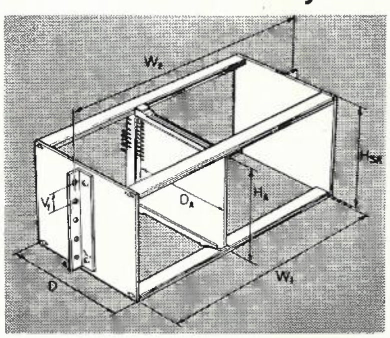
ISEP
Low-cost Modular Mechanical Mounting and Connecting System

ISEP (International Standard Equipment Practice) has been developed by ITT to provide a low-cost, comprehensive system of racks, sub-racks, plugs, sockets and accessories for the housing of electronic equipment.

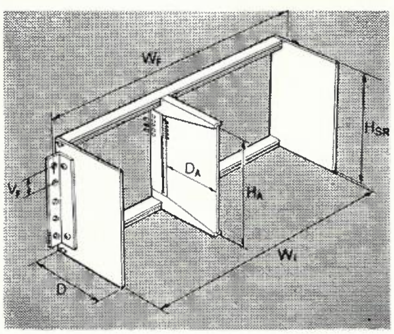
ISEP is manufactured and marketed by STC and can be supplied to meet exactly the requirements of equipment manufacturers.

The ISEP modular system offers the ultimate in simplicity and flexibility in sub-racks. It is assembled with four screws; guard rails and socket supports are fixed into the sub-rack by four special screws. Plugs and sockets are rated at 250 V. r.m.s., 4 A. per connector, have a contact resistance of less than 5m Ω and meet the highest professional specification. Whether mass-producing or making equipment to special order, you can obtain the benefits of high quality at low cost by using ISEP.

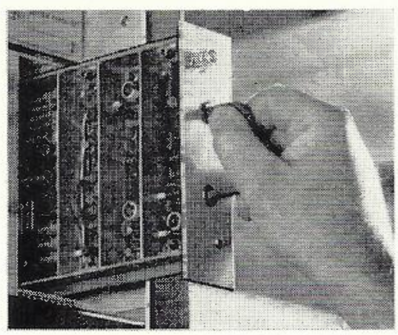
For illustrated technical booklet, write to: Standard Telephones & Cables Pty. Limited, Components Division, Moorebank Avenue, Liverpool, N.S.W. (Phone 602-0333).



Four-Rail Sub-Rack



Two-Rail Sub-Rack



Typical Installation

STC

world-wide telecommunications and electronics

AN ITT ASSOCIATE

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