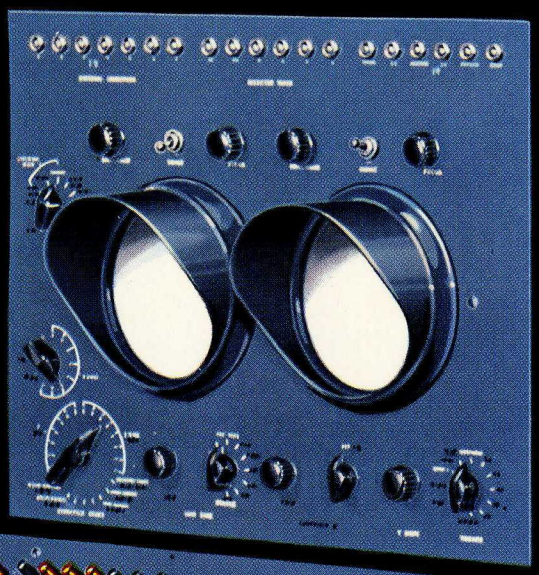
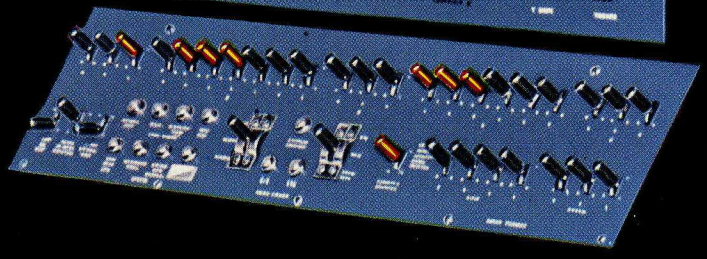
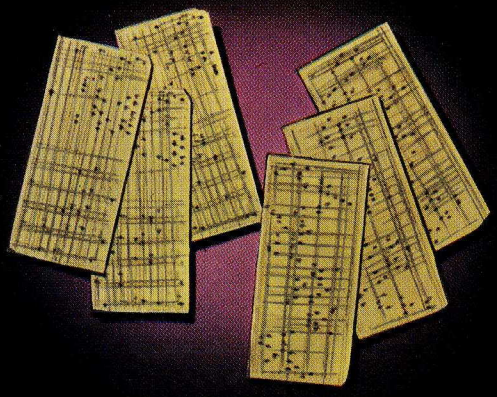






Ferranti Pegasus Data-Processing System

The Ferranti Pegasus

Data-Processing System

Introduction

THE FERRANTI PEGASUS DATA-PROCESSING SYSTEM is for use in commercial and administrative data-processing. It is fully proved and the first models have been installed. It is:

Very fast	**Flexible**	**Versatile**	**Reliable**	**Accurate**

and provides for most advanced techniques of programming

It is the most effective Electronic Data-Processing System yet produced by a European manufacturer.

Please pull out the picture of the complete System at the back of this brochure. This will help you to follow the detailed description.

The System consists of the well-tried Pegasus Computer and the following associated equipment:

Magnetic tape control unit

Up to eight magnetic tape mechanisms

Converter unit

(*which may, if the user wishes, have its own tape mechanism associated with it*)

Card reader

Card punch

High-speed printer

Applications

The System can quickly and efficiently carry out a wide variety of clerical, accounting and administrative work involving the processing of large files of information. Examples are:

Stock Control and Purchasing

Production Control

Sales Records and Sales Forecasting

Cost Analysis and Allocation between Departments

Public Utilities Billing

Payroll

Dividend Statements

Permanent files are kept on magnetic tape and amended as required. The System can select and print promptly from such files the statistical information needed by management.

Investigations are showing that the Pegasus Data-Processing System is capable of tackling administrative work on a surprisingly large scale. This is essentially because every part of it can be used very efficiently, and because many operations (*e.g.* checking) are done automatically by the equipment, instead of having to be carried out by instructions in the programme.

The flexibility of the equipment, and the flexibility resulting from the standard programming techniques, make the System very adaptable. This is of particular benefit when seeking to accommodate changes in the scale or the pattern of the administrative processes.

In consequence of its speed and versatility, the System or the computer on its own can be used for a remarkable variety of work in any medium-sized or large organisation. As soon as one job is finished a new programme is fed in and the equipment is available for the next job, which may be of an entirely different nature from the first.

The Pegasus computer is being increasingly used to investigate many problems with the new techniques of "industrial mathematics". These make it possible to carry out production planning, optimisation of processes, minimisation of costs, maximisation of output, and, in short, many tasks normally dependent on human judgement and long experience. The great computing power of Pegasus suits it particularly for this type of work, which may turn out to be the most valuable field of use of electronic systems in industry.

Many organisations have technical and statistical problems to be solved as well as administrative and commercial work to be done. For these the equipment is ideal.

The Equipment

It is convenient to look upon the complete System as two related but distinct parts:

1 **The Computer with Magnetic Tape Equipment**

The Punched Card and High-speed Printing Equipment **2**

Depending on requirements, it is possible to use the parts separately or together.

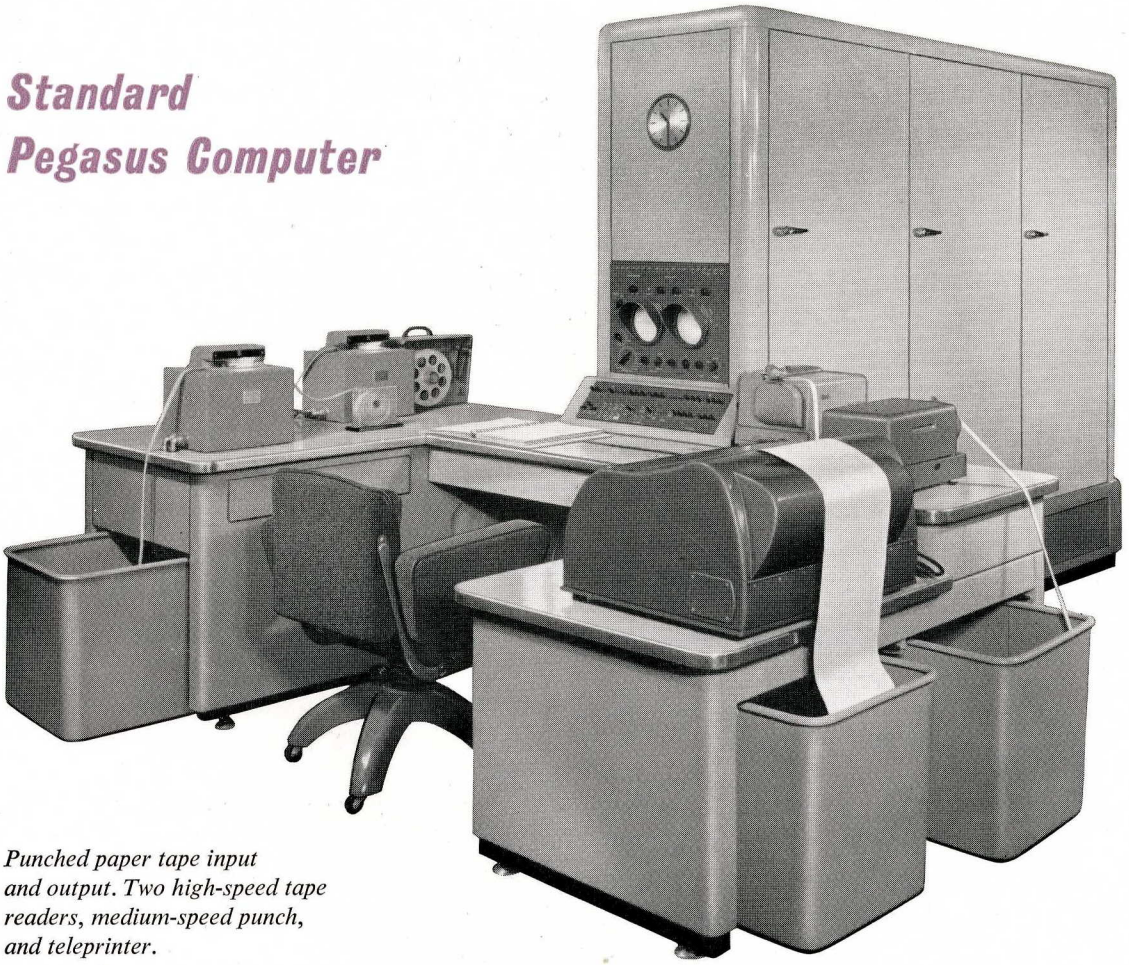
When using the former, information is put in and taken out by means of punched paper tape, with teleprinters or Flexowriters for typing the results. The data-processing is carried out by working with the magnetic tape mechanisms in conjunction with the storage and other facilities of the computer. Thus, one magnetic tape may be a brought-forward file, a second tape the amending information, a third tape the corrected carry-forward file, and a fourth tape the results to be printed out. Or, with other programmes, sorting of information from paper tape or on magnetic tape may be quickly and effectively carried out.

When it is convenient to use punched cards (perhaps with paper tape as well) the complete System is used. Information is then taken in from punched cards (or punched paper tape) and recorded on magnetic tape. The computer with its multiple tape units then processes the information. Finally, the results are taken from the magnetic tape and punched on cards or printed. The complete System is particularly valuable where large quantities of printed information are required.

Magnetic tapes may be prepared on the Converter while the computer is doing another job; this permits very intensive utilisation of the equipment.

The equipment (2) above can be added at any time to the computer with its magnetic tapes (1), if it is wished to start with the basic installation and extend it later.

Standard Pegasus Computer



Punched paper tape input and output. Two high-speed tape readers, medium-speed punch, and teleprinter.

The centre of the System is the Pegasus Computer, a medium-sized multi-purpose machine. The features which make it so satisfactory for technical calculations give it great versatility in data-processing work. Its exceptionally high computing speed is an important factor in making the whole System so fast.

A great deal of experience has been gained in using Pegasus, and a Library of standard programmes has been created. Particular care is taken that programmes for Pegasus should suit the widest possible range of problems, that they should be very flexible, and that they should be suitable for interchange between users.

Programmes written for a standard Pegasus with punched paper tape input and output can be run on the System without alteration. This is extremely important for those organisations which have both data-processing and technical applications.

PEGASUS

Pegasus - a successful Computer

1 Seventeen Pegasus computers were delivered and installed within 2 years from the prototype first working.

2 Each month another Pegasus comes off the production line.

3 More than 300 people attend Pegasus training courses each year; about 40 per cent have gone on to become full- or part-time programmers.

4 There are at least 80 groups writing programmes and preparing work for Pegasus.

5 It is estimated that *new* programmes for Pegasus are being written at the rate of over 400 per year.

6 The Library of standard programmes for Pegasus is believed to be superior to that for any other computer, in the quality of the programmes and the ease with which they may be used.

7 Ferranti offer a full service to enable Pegasus owners to use existing programmes.

Reasons for its Success

1 The reliability of the computer.

2 The quality and extent of the programmes, and the programme service.

3 The design of the computer, which again has three facets:

a) The machine was designed to meet the requirements of programmers, thus placing it in a different category from other contemporary computers.

b) Experience has shown that a most happy balance has been attained between all its facilities.

c) Each part of it has been thought out in terms of all the other parts, so that the user finds they combine together for the maximum effectiveness.

Magnetic Tape Mechanisms

Files of information are held on reels of magnetic tape. The actual processing of this information is done by passing streams of information through the computer, amending, adding to or extracting from them as required, and copying on to other reels of magnetic tape.

Although as many as nine magnetic tape mechanisms may be used in the Pegasus Data-Processing System, four will be sufficient in many installations.

Magnetic Tape

The magnetic tape used in the System is half an inch wide and is supplied in multiple lengths of 600 ft., with a maximum of 3,000 ft. in one reel.

Information is stored on the tape in either 16- or 32-word sections.* A 3,000 ft. reel can, for example, hold about 8,500 32-word sections (270,000 words) or 11,000 16-word sections (175,000 words); this corresponds to nearly two million alpha-numeric characters on each reel.

Each section has its own "address" on the tape, from 0 through to the maximum, so that it can be readily located. It is tested to ensure that the tape is fault-free. The layout of a length of tape may be compared to a road divided into plots on which detached houses will be erected. Each suitable plot has its identifying number.

It is possible to make any one, or any number, of the tape mechanisms search for required addresses on the tapes, and then wait. Searching can go forwards or backwards. In all reading or writing (recording) operations, there is also an automatic search to the specified address.

At the end of a job, or at the end of a reel if several are used, the reel can be rewound quickly; any number of the tape mechanisms can be rewound simultaneously.

Magnetic tapes must be reliable as well as fast. Pegasus tapes carry the following checking facilities to ensure no mistake can get through:

1. A parity bit associated with each word.
2. A check sum after each section. This and the previous check correspond to cross-casting.
3. Reading check immediately after each item is written.
4. Reading check on previously recorded information.
5. Automatic repeat of reading if an error occurs.
6. Checks that the tape equipment as a whole is working correctly.

All checks stop the machine at the instant an error occurs, so that erroneous information cannot be processed further. All checks are carried out automatically by the equipment, so that no additional effort is required from the programmer.

NOTE

** A "word" is a string of digits or letters making up a number (up to 11 decimal digits) or an assembly of numbers and letters. If the user is concerned with smaller numbers, or assemblies of letters and numbers, he can "pack" several into a word.*

Tape Control Unit

This unit couples the magnetic tape mechanisms to the computer. It has circuits to control and lay out the information on the magnetic tapes, and for automatic checking.

It also contains a buffer store – a waiting-room between a tape mechanism and the computer. This can be filled from or emptied on to magnetic tape at speeds appropriate for the tape, the computer meanwhile being free to do its work at true electronic speed.

Tape Control Unit

This unit controls up to eight magnetic tape mechanisms and connects them to the computer. Information is transferred to and from magnetic tape and the computer via the buffer store, which can hold 32 words.

Magnetic tape operations do not hold up the computer.

While information is being read from magnetic tape into the buffer store,
or being written from the buffer store on to magnetic tape,
or an address on the magnetic tape is being searched for,
the computer can continue to operate on numbers which it has already been given. No time is wasted.

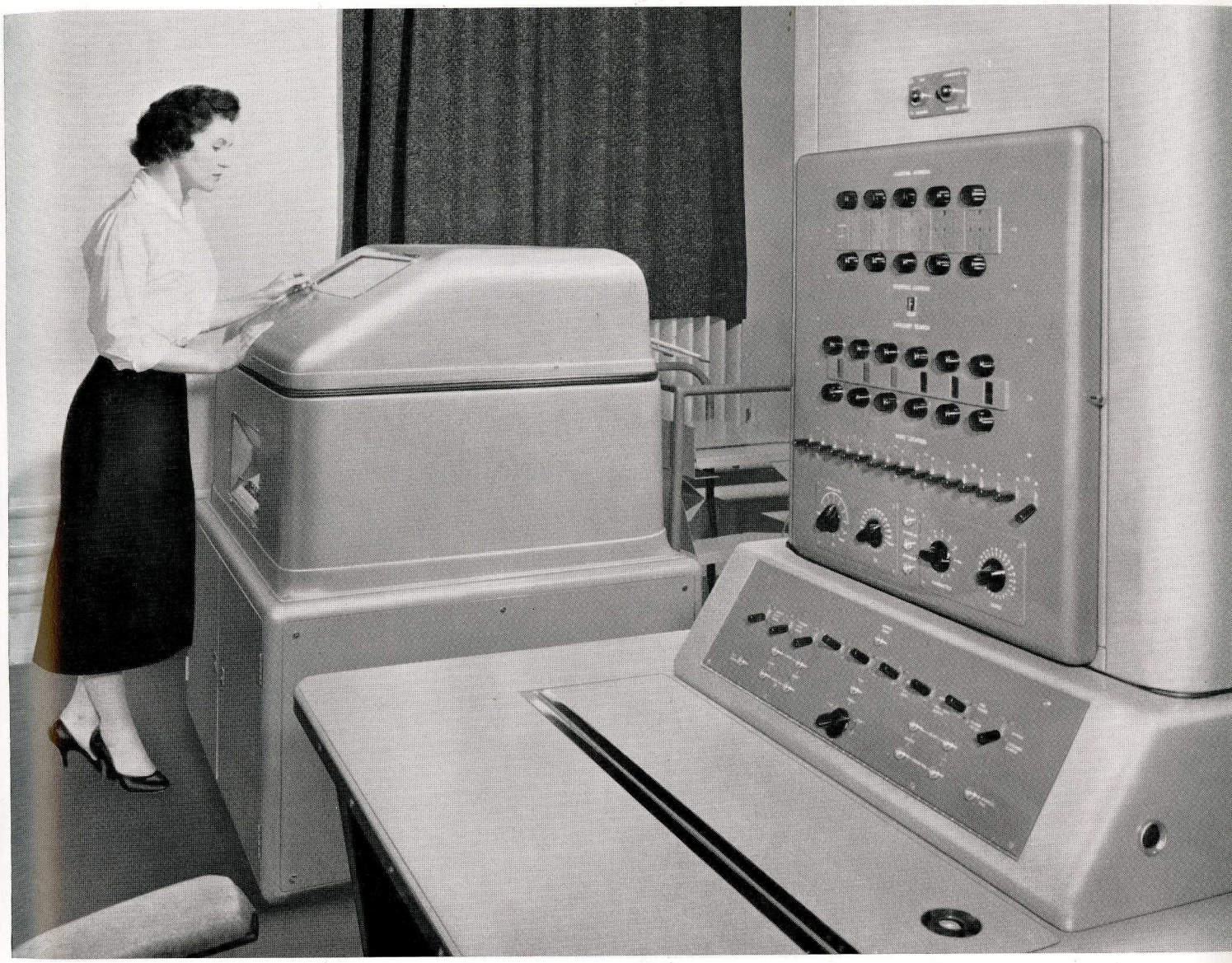
To transfer a 16-word section from the magnetic tape to the buffer store takes 41 milliseconds, a 32-word section 53 milliseconds. But to transfer information from the buffer store to the computing store of Pegasus takes only $1\frac{1}{4}$ milliseconds for an 8-word block – 5 milliseconds for the total contents of the buffer store. The computer receives the whole of the information quickly and can immediately work on it.

Moreover, the buffer store consists of two independent halves, so it is possible for a 16-word section to be transferred to or from magnetic tape with one half, while in the other half a 16-word section is being transferred to or from the computer.

Although the magnetic tape equipment with the Pegasus computer is usually thought of for data-processing, it can also be considered simply as an extension of the storage capacity of the computer. This is particularly valuable for very large technical calculations, and for work using the "industrial mathematics" techniques such as "linear programming".

Typical installation of the Ferrant

The Pegasus computer and four magnetic tape mechanisms. The computer is equipped with refrigeration ducting.



The control panel of the converter unit and the high speed printer.

Converter

Links a magnetic tape mechanism to auxiliary equipment.

The converter is the centre of the second group of equipments forming the full Pegasus Data-Processing System. It makes it possible to transform information between punched cards and magnetic tape (either input or output) or from magnetic tape to a fast printer.

While it is being used – at speeds determined by the card machines or the printer – the computer with its magnetic tapes is free to do other work.

It has carefully planned switches, and contains circuits to transform the information between the various media and automatically convert the codes, to start and stop the machines, to control the layout of the printing and to check every operation.

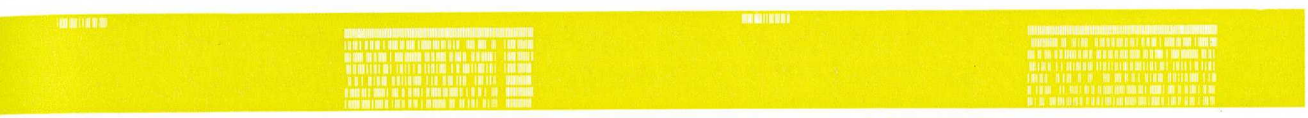
The Converter

The scope and versatility of the magnetic tape system can be enlarged by the addition of a converter unit, by means of which one of the tape mechanisms on Pegasus can be linked to:

a card reader,
a card punch, or
a high speed printer,

leaving the tape control and computer in charge of the remaining tape mechanisms.

By the use of the converter the computer can be fully integrated with an existing punched card installation.



This converter operates entirely independently of the computer, which is thus not tied to the speed of card-working or printing and is in fact free to carry on with calculation. Operations with the converter and the computer can be carried on simultaneously.

The converter can be switched to one of the magnetic tape mechanisms associated with the computer, or it may optionally have a tape mechanism of its own.

All operations are selected under the control of switches on the desk of the converter unit. It does not have to be programmed. Once an operation has been set up on the control switches then that operation is followed through automatically without any further action by the person in charge. Stopping and starting, conversion, layout of information, and checking are all arranged by the converter.

Both the stopping and starting addresses of the sections on the magnetic tape can be specified and thus any operation can be performed on only those *sections selected.* This ability to select and operate on particular groups of information is extremely valuable in administrative work. An important consequence is that it makes it possible to use the tape mechanisms more efficiently, so that fewer mechanisms are required than would be needed with a less sophisticated system.

Like Pegasus, the converter unit is of packaged construction and has its own monitoring facilities. This greatly simplifies and speeds maintenance.

Punched Cards

Information on punched cards is taken into the System by the card reader, passing via the converter to magnetic tape.

Conversely, when it is required to put information from the System on to cards, it is taken from magnetic tape, through the converter, and punched on the cards.

Machines can be provided for Powers-Samas cards, or for Hollerith or I.B.M. cards.

PUNCHED CARD ➡ MAGNETIC TAPE *Conversion*

80-column cards are converted to 16-word sections on magnetic tape. Each column of a card is represented on magnetic tape by 6 binary digits and a Pegasus word of 39 binary digits can thus accommodate 6 characters, giving a total of 96 character positions in a 16-word section. The distribution of the 80 columns of the card over the 96 character positions of the tape is carried out by means of a plugboard mounted on the reader.

All 80 columns of a card are converted and it also is possible on a re-run to deal with the inter-stage punching on Powers-Samas cards.

The card feed rate is 200 cards per minute.

The process can be started and stopped at any specified addresses on the tape.

Very thorough checking devices have been built in for the purpose of checking card reading and tape writing. The most important comprise double-reading of each card before it is recorded, and the full set of checks on the magnetic tape. There are many others. All failures cause the equipment to stop. The type of failure is indicated on the control panel and the operator can take appropriate action.

MAGNETIC TAPE ➡ PUNCHED CARD *Conversion*

This reverse process is similar except that the card punching rate is 100 cards per minute.

Similar facilities are provided. Thus all 80 columns on the card may be punched, and the layout can be determined by plugboards. The process can be started and stopped at any specified addresses on the tape. There is automatic code conversion, and complete automatic checking – this including a check-read of the cards after punching.

Printing

Results may be printed very quickly on this equipment, which prints a line-at-a-time. The documents are very clear and legible.

A full range of letters, numbers and punctuation symbols is available. Pre-printed forms, or carbon duplicates, may be used.

Information on magnetic tape is passed through the converter to actuate the printer. Exceptionally comprehensive editing and controlling facilities are provided in the converter. In consequence, all the output from a job may be put on the tape by the computer in a single operation; parts of this are then selected, edited and the layout controlled, during subsequent passages of the tape through the converter.

MAGNETIC TAPE ➡ LINE-AT-A-TIME PRINTER

The printer prints a line of up to 92 character positions at the rate of 150 lines per minute. The 96 characters of a 16-word section are distributed over the 92 character positions by a plugboard. Altogether 39 printer characters are available, figure 1 and letter I being common, as are zero and the letter O.

Exceptional editing facilities are available:

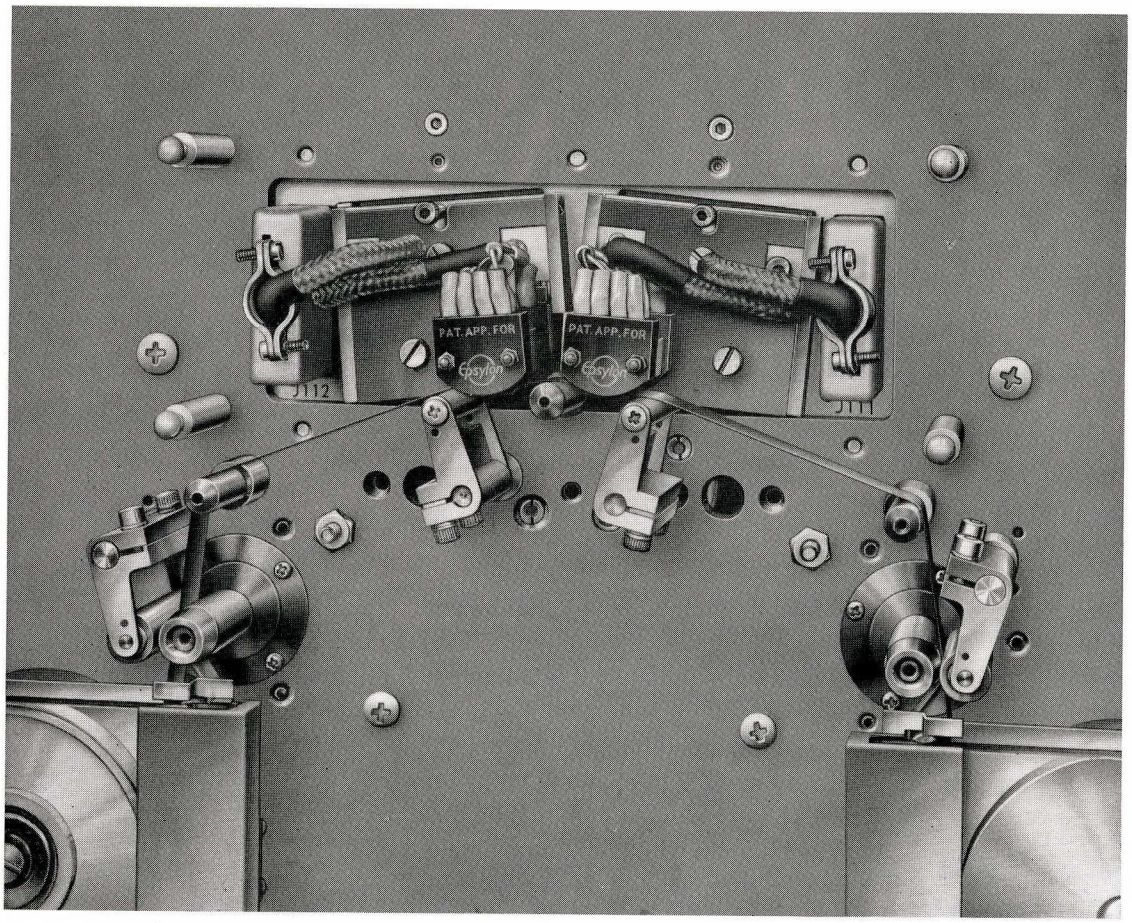
The category search facility enables the System, when printing from tape, to select only those sections containing particular combinations of words or characters, *e.g.* all the part numbers of a particular group, or all the employees with the same tax code number. Those sections which do not contain these combinations will be ignored by the simple setting of a switch. The value of this category search facility in commercial or statistical work can readily be appreciated.

Suppose, for example, the computer in processing a file has tagged items of particular importance, *e.g.* with a symbol to indicate stocks below warning level or below danger level. The category search facility may then be used to print out only the items tagged with the below warning level symbol, W, at say weekly intervals, and all the items below the danger level at more frequent intervals, *e.g.* daily.

Flexibility is also increased by the use of special editing characters which control the sections and words, or parts of them, that are to be printed; others arrange for the insertion of line feeds or initiate paper throw. Any desired layout can easily be obtained by the use of these special editing characters either singly or in combination.

The process can be started and stopped at any specified addresses on the tape.

Again, thorough checking procedures are incorporated and any failure stops the printing. Especial care has been taken to prevent any decimal digit being erroneously changed into another decimal digit.



A close-up of a magnetic tape mechanism. Information is recorded on the tape with the left-hand group of heads, and immediately checked by the reading heads, the right-hand block. Tape is driven in either direction by the lowest rollers shown, which rotate continuously in opposite directions; the tape is pressed against one or other drive roller by a clamping roller mounted on a cranked arm.

Checking

Very thorough checking methods have been incorporated throughout the System, so that it is extremely rare for any malfunctioning of the equipment to pass undetected. In particular, the checking associated with the magnetic tapes is exceptionally comprehensive. All checks are carried out automatically by the equipment, so that it is unnecessary for the programmer to make further provision for them. Checks are designed so that the equipment is stopped immediately an error occurs, to prevent erroneous information from being processed.

THE MAIN CHECKS COMPRISE:

1) With every word there is a parity digit; this is carried through the computing, main and buffer stores, the magnetic tape and the converter. It checks against the loss or gain of any one binary digit.

2) As each section is recorded on the magnetic tape, a check sum is formed by the electronic circuits and automatically recorded beyond the end of the section.

3) Immediately after recording on magnetic tape (whether from the computer or from cards), the information is read back and the check sum is automatically verified. This ensures that all information is put on the tapes correctly.

4) On reading from magnetic tape (to the computer or alternatively to punched cards or for printing) a check sum is again formed automatically and compared with that recorded. This ensures that there are no reading errors.

5) If the reading check of 3 or 4 above fails, the tape is automatically moved back and another attempt made at reading. Most reading errors are caused by dust specks, and this violent reversal usually dislodges the dust and correct reading ensues. Up to 8 re-reads are allowed, and if the check still fails the whole equipment is stopped.

6) Cards are read twice and compared before being recorded on tape.

7) Cards are check-read after punching.

8) The codes used for punched paper tape, and for printing, are such that it is very unlikely for any number to be erroneously changed into another number.

9) If during calculation a number is formed which is too big for the capacity of a register, the computer is stopped as soon as any attempt is made to store this away in either the main store of the computer or on magnetic tape.

10) Comprehensive interlocks are provided between all parts of the System, so that nothing can go wrong as a consequence of mistiming in the programme. This facility is of immense importance, for not only does it remove from the programmer many of the burdens of timing, but it also permits programmes to be written which are not affected by those changes in the scale or form of the problem which influence the timing.

Speeds

The System has been designed to allow each part to be used at its maximum speed and efficiency. Further, it is possible to operate several processes simultaneously. In particular, by having the converter the computer is not tied to the speed of card working, or printing; it is in fact then free to do other work – data-processing or technical calculations. Also, the buffer store permits the computer to obey programmes while the magnetic tapes are being moved to the correct place, or information is being recorded or read; the final transfer of information between the buffer store and computer is very rapid. When using 16-word sections, the two halves of the buffer store may be used independently.

THE SPEEDS GIVEN BELOW REPRESENT FULLY CHECKED OPERATION

1) Card reading on to magnetic tape, 200 80-column cards per minute.

2) Card punching from magnetic tape, 100 80-column cards per minute.

3) Printing from magnetic tape, 150 92-character lines per minute.

4) Two paper tape readers, at 200 characters per second.

5) Punched paper tape output, 33 characters per second, with faster punches expected to become available.

6) Teleprinter output, 10 characters per second (transcribing from the punched paper tape output).

7) Magnetic tape searching, 24 16-word sections or 19 32-word sections per second.

8) Magnetic tape reading to, or writing from, buffer store, 41 milliseconds per 16-word section or 53 milliseconds per 32-word section.

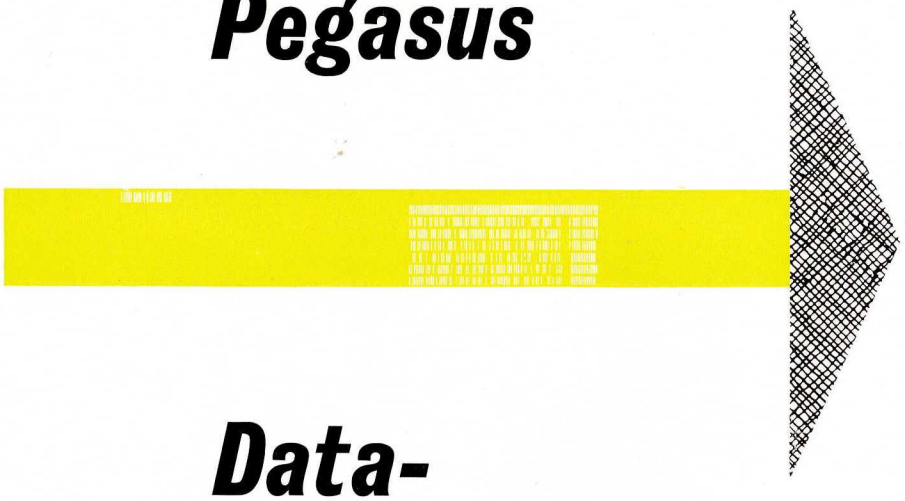
9) Transfers between buffer store and computing store of Pegasus, 2·5 milliseconds per 16-word section or 5 milliseconds per 32-word section.

10) Magnetic tape rewind, total time of 4 minutes for a full 3,000 ft. reel.

NOTE:

In items 4, 5, 7, 8 and 10, once the computer has given the initiating order (taking 0·3 milliseconds), it is free to obey other orders. Comprehensive interlocks are provided to prevent malfunctioning if a subsequent related order is given too soon.

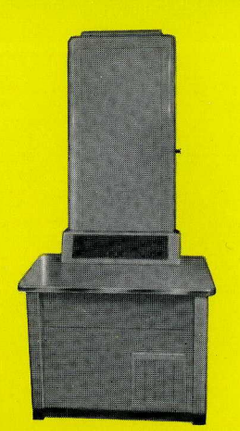
The Ferranti Pegasus



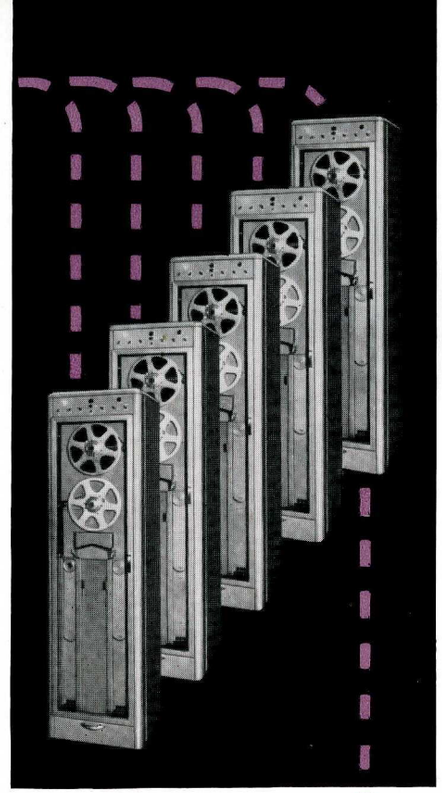
Data-Processing System

Information is taken into the System from punched cards (or punched paper tape) and converted on to magnetic tape. The computer with its multiple tape units then processes the information. Finally, the results are converted from magnetic tape to punched cards or a fast printer.

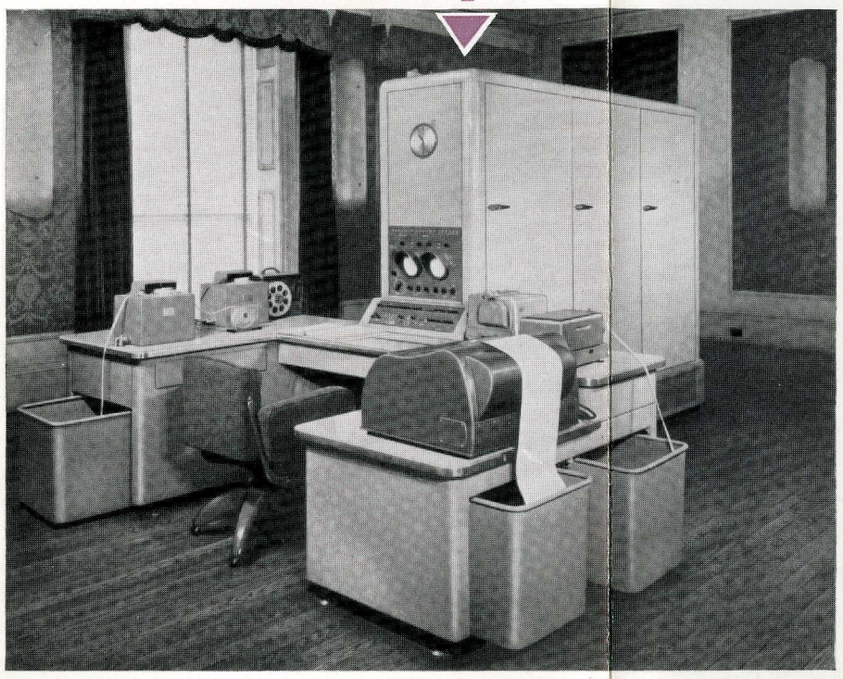
MAGNETIC TAPE CONTROL UNIT.
Buffer store, checking circuits, tape control circuits.



MAGNETIC TAPE MECHANISMS.

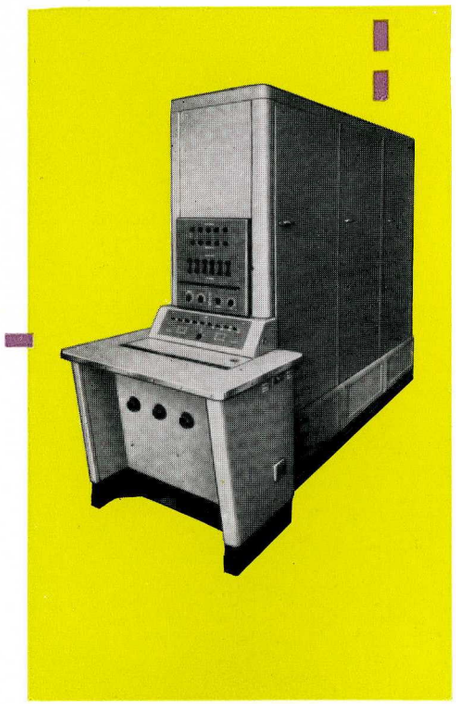


HIGH SPEED PRINTER.
Prints 150 lines per minute. 92 alpha-numeric characters in each line.

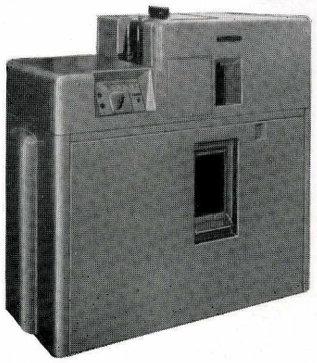


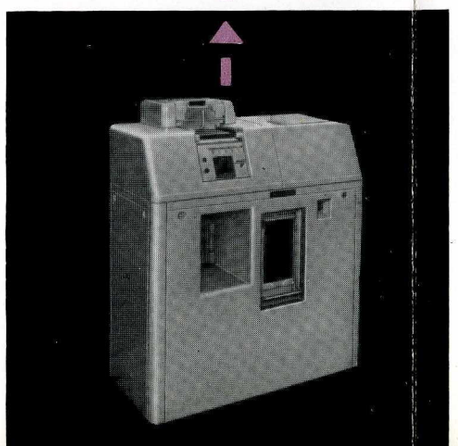
CONVERTER.
(Linking a magnetic tape mechanism to auxiliary equipment.)

STANDARD PEGASUS COMPUTER.
Punched paper tape input and output. Two high-speed tape readers, medium-speed punch, and teleprinter.



CARD PUNCH.
Punches 100 cards per minute. 80-column cards.





CARD READER.
Reads 200 cards per minute. 80-column cards.

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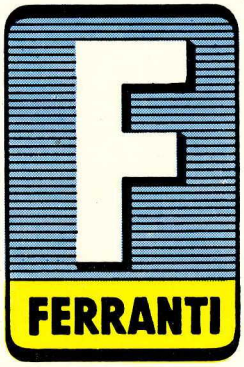
OCTOBER 1958

Printed in England PLH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