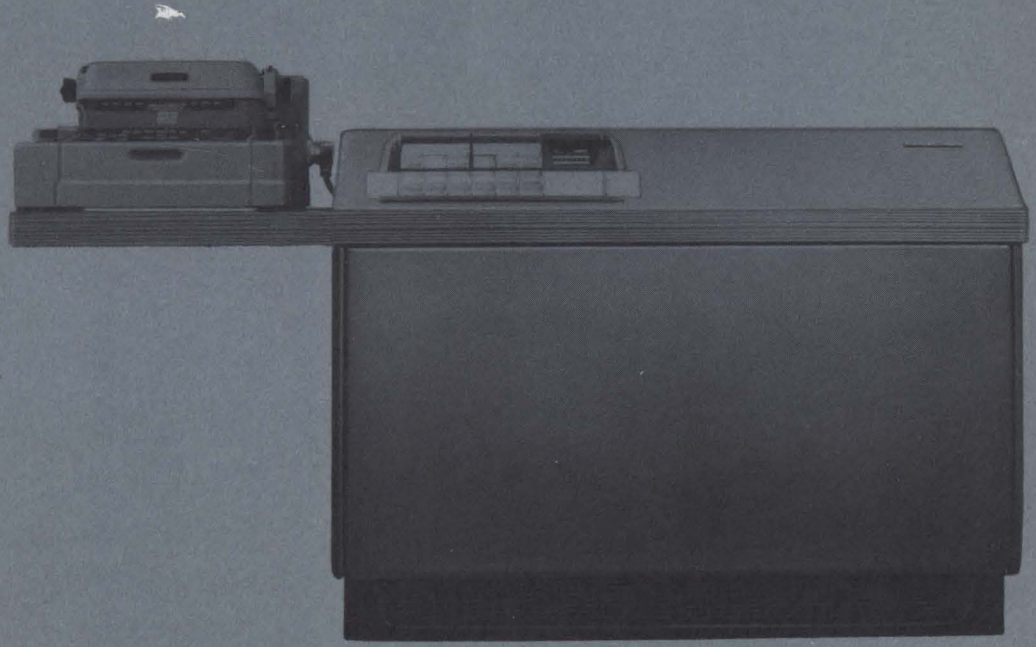
LGP-30

THE ROYAL PRECISION ELECTRONIC COMPUTER



LOW COST

SMALL SIZE...MOBILE

SIMPLIFIED PROGRAMMING

LARGE MEMORY

RELIABLE PERFORMANCE

LGP-30

The LGP-30 is a serial, single address, fixed point, binary, stored program digital computer. It fulfills the need for a small-sized, reliable and low-priced scientific computing device. It has a large memory capacity yet its general physical configuration offers a new approach in computer design philosophy so that it has been kept small in size.

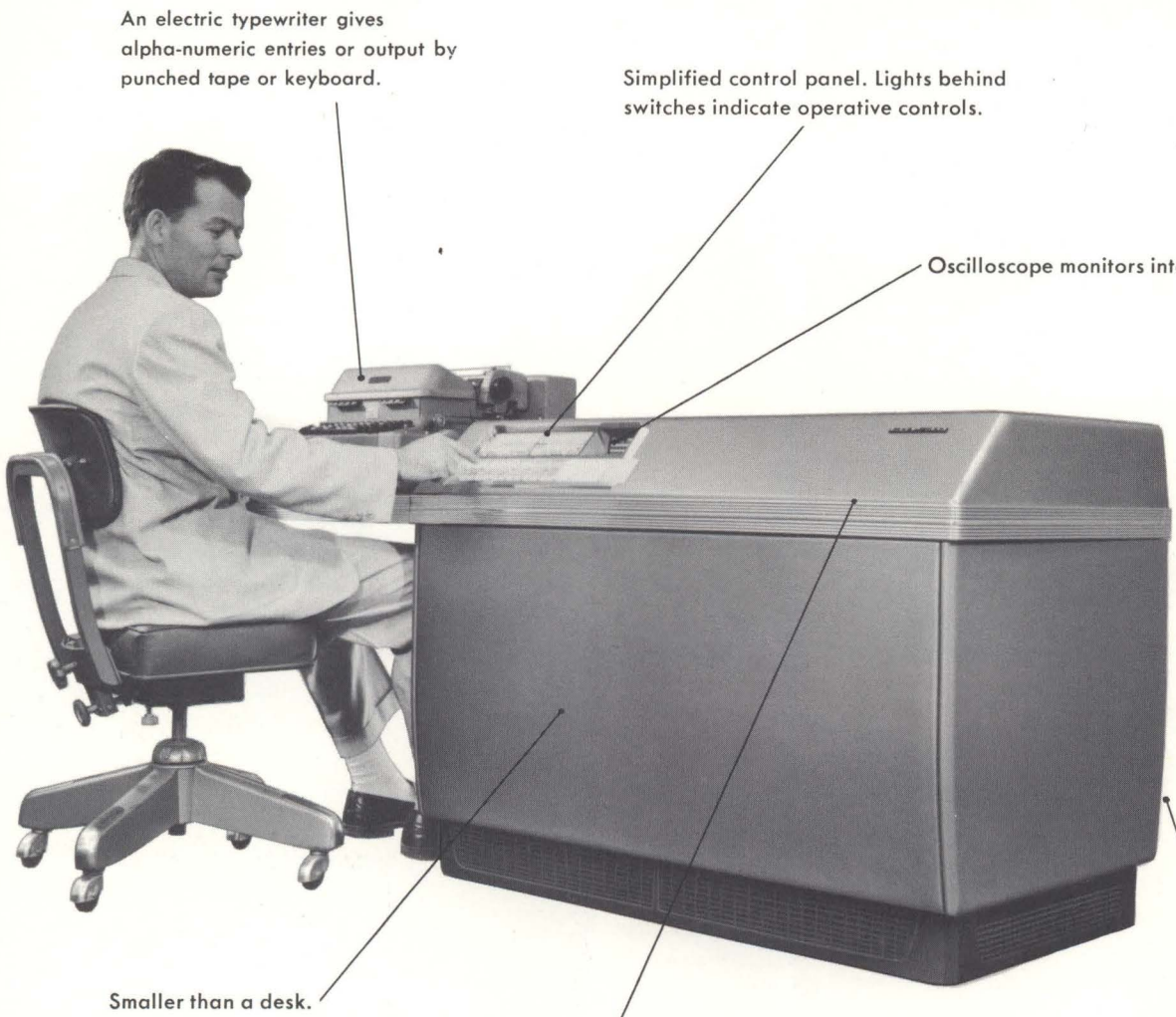
The LGP-30 has an integrated logical design that utilizes each component for many operations. This results in simplicity of design since fewer components are required and each does useful work most of the time.

SMALL SIZE...MOBILE

Because it is desk-sized and mobile, the LGP-30 can be rolled from the computing center right to the engineer's desk, close to his project. It operates from a conventional wall outlet and requires no special installation or external air-conditioning equipment.

RELIABLE PERFORMANCE

The quality components of the LGP-30 are operated under conservative loading conditions. Major assemblies are of Librascope design, including the drum and heads, logic board, flip-flops and other printed circuit cards embodying latest design techniques.



SIMPLIFIED PROGRAMMING

Operation of the LGP-30 may be easily mastered by the average engineer. Its relatively simple command structure makes the computing task easier for the expert and brings it well within the grasp of the occasional user. Non-technical personnel may be trained very quickly to carry out actual computer runs.

LARGE MEMORY

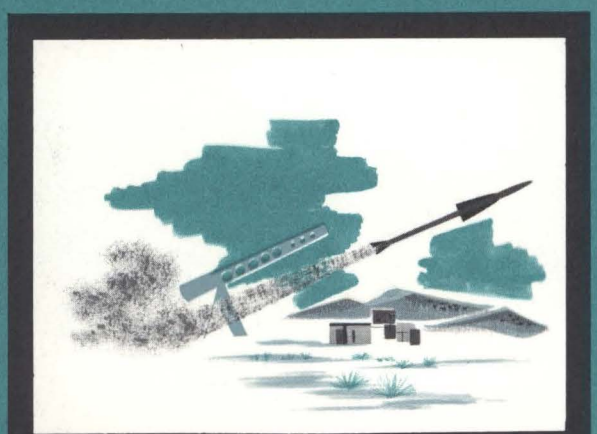
The magnetic drum memory holds 4096 words. This feature gives the LGP-30 a memory capacity suitable for the majority of complex scientific problems that might be assigned to an automatic computer. Stored program operation means greater flexibility so all programs may be internally self-modifying.

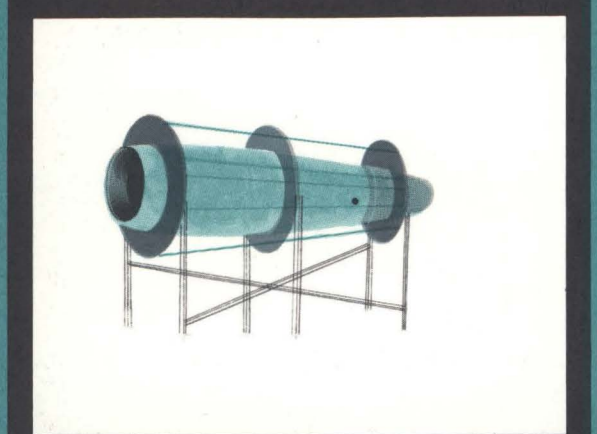
LOW COST:

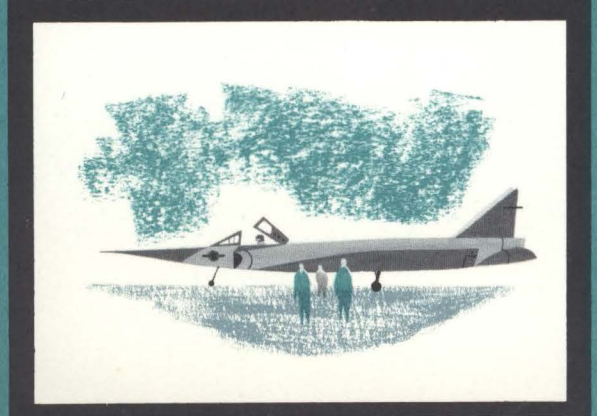
Design simplicity results in a smaller machine and a smaller initial investment. Less time is spent in checkouts and maintenance; programming costs are lower, and fewer hard-to-find computer personnel are needed. Extensive school courses are eliminated for most operating and maintenance personnel.

applications:

Since the LGP-30 is a truly universal computer, the range of calculations it can perform–and the scope of its applications–is almost limitless. It may be programmed to solve problems of extreme complexity...yet the operator achieves his purpose with a very simple command structure. This partial list of applications suggests rather than defines the usefulness of the LGP-30.







RESEARCH

Mathematical solutions for problems involving:

Matrix inversion
Simultaneous equations
Partial differential equations
Eigenvalues
Least squares fit
Fourier synthesis (as in X-ray diffraction)

or the analysis of:

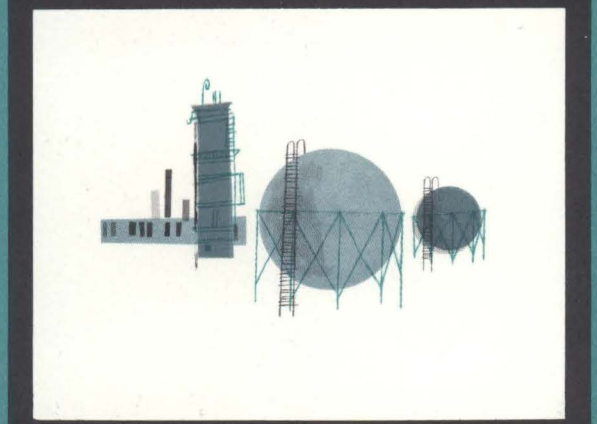
Regressions
Variances
Test scores
Partial regression coefficients
Weighted averages
Trajectories
Linear systems

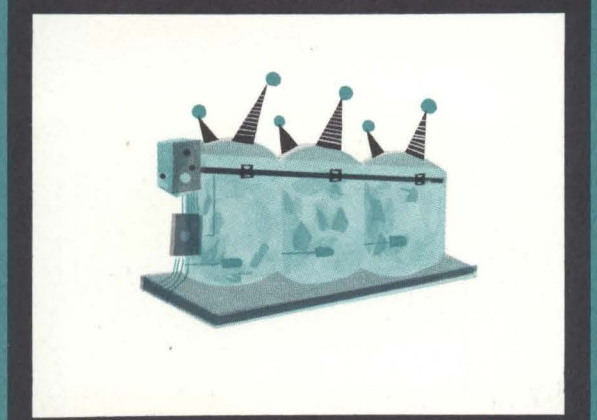
or functions such as:

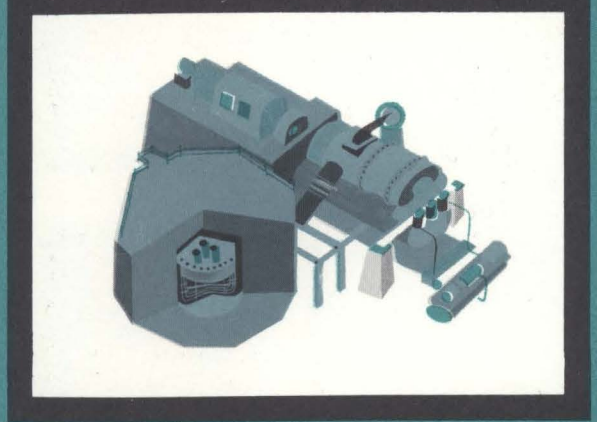
Composition of special mathematical tables
Data reduction
Non-arithmetic calculations
(such as Boolean algebra)

APPLIED ENGINEERING

Computer studies, utilizing the mathematical functions already described, or combinations thereof, may be of paramount importance in the development of new equipment or the most efficient use of present equipment. The LGP-30 has a wide application throughout industry in these studies. Those listed below only begin to demonstrate its versatility:







SUGGESTED LGP-30 USES IN INDUSTRY

aircraft

Reduction of wind tunnel test data
Missile development studies
Jet engine test analysis
Development of airfoil sections
Stress and weight studies
Circuit designs
Antenna field calculations
Data reduction of aerial surveys

nuclear

Nonlinear hydrodynamic equations
Diffusion theory
Monte Carlo techniques
Cross section criticalities
Energy group variations
Quantum mechanics studies
Reactor geometry

petroleum

Marketing outlet studies
Batch combination determinations
Design of processing equipment
Correlation of seismic records
Pipeline network design
Reservoir engineering studies
Well-logging interpretations

steel

Correlation methods to study operation of open-hearth furnaces

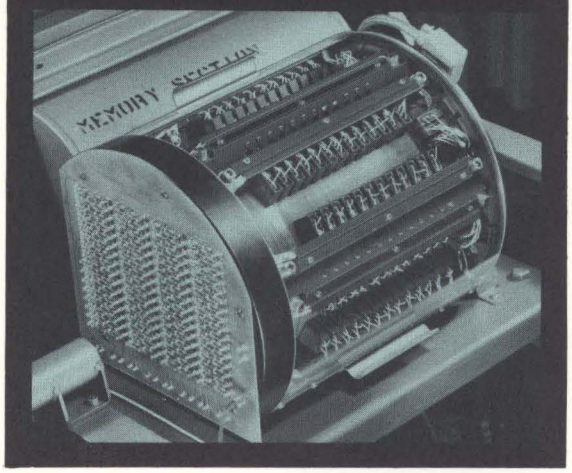
utilities

Design of power transformers
Transmission line calculations

general

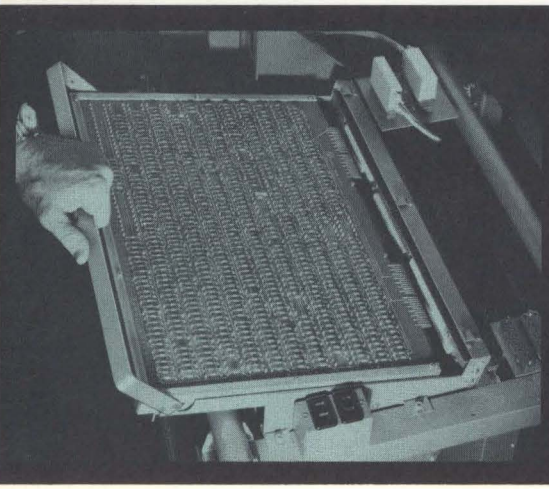
Bearing load calculations
Cam designs
Dynamometer test data reduction
Electro-magnetic theory studies
Feedback network design
Fluid dynamics
Optical ray tracing
Orifice calculations
Pipe stress studies
Spectrographic data reduction
Servo stability analysis
Linear programming
(to discover effective combination of raw materials and production facilities for optimum profitable output.)

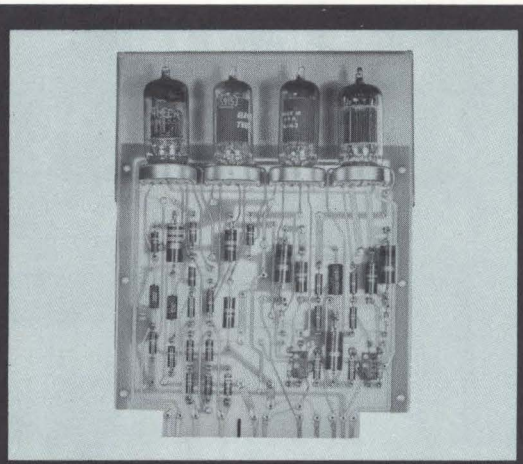
components



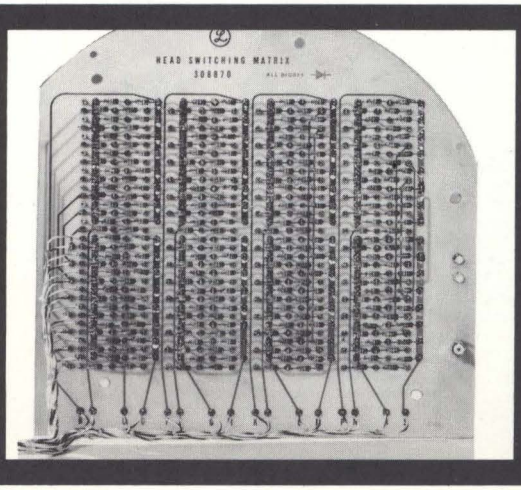
drum and heads

logic board

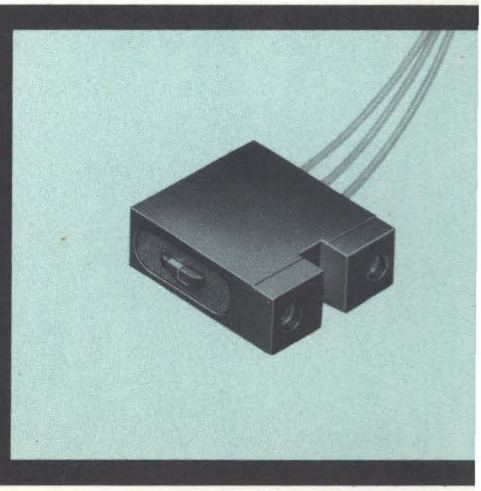




plug-in card



head-switching matrix, memory



unmounted read-record head

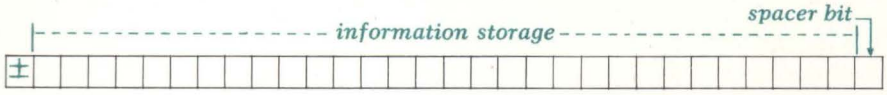
LGP-30 *operation*

The LGP-30 will operate on both alphabetical and numerical information. The computer is internally binary, which permits a desirable simplicity of design, yet imposes no restriction on the operator, who enters information in customary decimal form and receives the results in decimal form. Conversion is made by a standard input-output routine stored on the memory drum.

The memory drum provides for 81 magnetic recording channels, each equipped with one or more read and record heads. Sixty-four of these channels comprise the main memory, used for storage of data to be operated on, and for storage of instructions for the computer. Three channels are "active memory," or recirculating channels for temporary storage of: 1) data being operated on (accumulator register); 2) instructions in use (instruction register); and 3) a number that controls the sequence of operations (control counter register). The timing signals which guide the computer in finding specific locations on the drum occupy 3 channels. Extras are for special use.

A channel in the main memory consists of 64 words, each containing 32 binary digits (bits). In the case of a word that is used only for storage of data to be operated on, one bit indicates the sign, 30 are used for information storage, and one is a spacer bit:

INFORMATION STORAGE WORD



A word used for storage of an instruction consists of a command from the list at right, and the memory drum address where the data to be operated on will be found. The extra bit spaces in the word may be used for storage of constants or special tallies.

INSTRUCTION WORD

There are four phases involved when the LGP-30 executes an instruction:

1. A search is made for the instruction word to be used, at the memory address specified by the control counter register.

2. The instruction word is transferred from the main memory to the instruction register.

3. A search is made for the data word containing one of the operands, at the address specified in the instruction word. The second operand is in the accumulator register as a result of a previous operation.

4. The computer performs on the operands the action specified in the command.

The LGP-30 gives the programmer a unique interlaced pattern of word addresses which greatly simplify the reduction of memory access time. The stored program operation of the computer makes it possible for a program to be self-modifying, thus increasing flexibility still further.

THE COMMAND TABLE

code letter of command	*command*
B	Bring
A	Add
S	Subtract
M	Multiply, fractional
N	Multiply, integral
D	Divide
H	Hold
C	Clear
Y	Store address
R	Return address
E	Extract
U	Transfer control
T	Test
I	Input
P	Print
Z	Stop

explanation of commands

(Note: "m" is the memory location specified in the address portion of an instruction)

BRING Replace the contents of the accumulator with the contents of memory location m.

ADD Add contents of m to the contents of the accumulator, and retain the sum in the accumulator.

SUBTRACT Subtract the contents of m from the contents of the accumulator, and retain the difference in the accumulator.

MULTIPLY Multiply the number in the accumulator by the number in memory location m, terminating the result at 30 binary places, and retaining the most significant half of the product in the accumulator.

MULTIPLY N Multiply the number in the accumulator; by the number in memory location m, retaining the least significant half of the product in the accumulator.

DIVIDE Divide the number in the accumulator by the number in memory location m, retaining the quotient (rounded to 30 bits) in the accumulator.

HOLD Store contents of the accumulator in m, retaining the number in the accumulator.

CLEAR Store contents of the accumulator in memory location m, clearing the accumulator.

STORE ADDRESS Store only the address part of the word in the accumulator in memory location m, leaving the rest of the word in m undisturbed. (Useful when the operator wishes to modify the address portion of an instruction.)

RETURN ADDRESS Add "one" to the address held in the control counter register and record it in the address portion of the instruction in memory location m. The control counter register normally holds the address of the next instruction to be executed.

Thus to call a subroutine into action requires only two words of instruction, neither affecting the accumulator; an R *m* and a U *n*, (where *m* is the address of the end of the subroutine, *n* of its beginning.)

EXTRACT The extract command clears the number in the accumulator to O, where the corresponding digit of the number in m contains a O. This command is useful when several pieces of information are stored in one word and must be sliced apart for separate use.

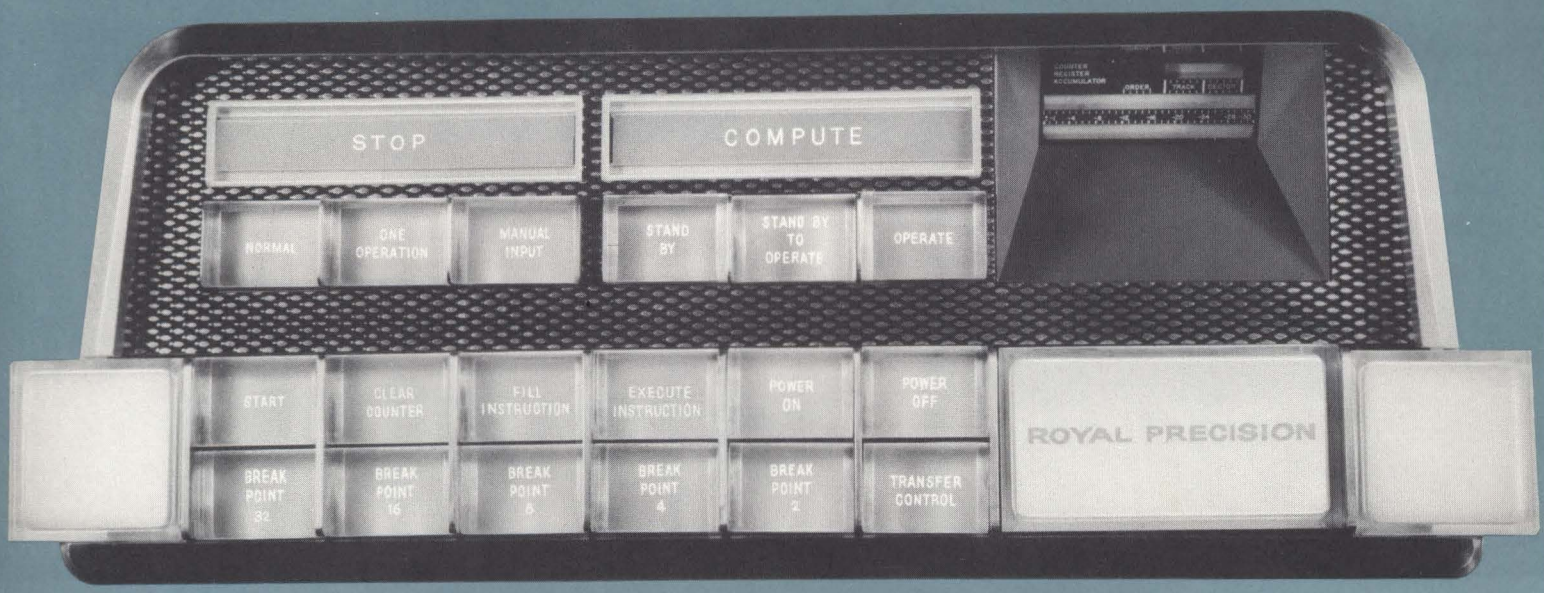
TRANSFER CONTROL Transfer control to m unconditionally, i.e., get the next instruction from memory location m. This allows a control of the sequence in which instructions are executed.

TEST Conditional transfer. Transfer control to memory location m only if the number in the accumulator is negative. Otherwise the Test command is ignored. This command permits the introduction of branching or decisions in a sequence of operations, contingent upon the results of computation.

INPUT This command fills the accumulator from the electric typewriter. If tape input is being used, tape reading continues until a stop code is read.

PRINT Print an electric typewriter symbol. The symbol is denoted by the track number part of the address in an instruction word. When executing this command, the computer has complete control of the typewriter functions, including decimal digits, letters, punctuation marks, shifts, tabs, carriage return and any other operation the typewriter can perform. This permits complete flexibility in the format of the output, including simultaneous punching on tape, if desired.

STOP The stop command can be unconditional, or can be made contingent on five break point switches on the control panel. This command enables the operator to stop the program at selected points when desired. (See "Break point" section of control panel description.)



control panel

The LGP-30 control panel was designed with emphasis placed on simplicity of operation. The operator can concentrate upon his problem rather than upon operating the machine.

OSCILLOSCOPE. The *oscilloscope* displays the contents of the Control Counter register, the Instruction register, and the Accumulator register.

POWER ON-OFF. The *Power on* and *Power off* switches are the main power switches.

OPERATE. The *Operate* button initiates an automatic warm-up cycle which prepares the machine for operation.

STANDBY TO OPERATE. The *Standby to Operate* indicator shows that the computer is in its warm-up cycle.

STANDBY. The *Standby* button stops the drum and reduces tube heater voltages during inoperative periods, to prolong component life.

NORMAL, ONE OPERATION, INTERROGATE. The three modes of operation in the LGP-30 are selected by these three buttons. In the *Normal* mode, the machine executes the instructions of the stored program automatically. In the *One Operation* mode the machine executes one instruction of the program and stops. In the *Interrogate* mode, a number may be entered into the accumulator directly from the electric typewriter keyboard or from punched paper tape. These buttons are interlocked.

These buttons establish only the mode of operation and do not cause the machine to operate.

START. The *Start* button initiates all operations.

CLEAR COUNTER. The *Clear counter* switch resets the control counter register to zero to simplify restarting a program.

FILL INSTRUCTION. The *Fill Instruction* button causes the transfer of an instruction held in the accumulator register to the instruction register.

EXECUTE INSTRUCTION. The *Execute Instruction* button causes the instruction which is in the instruction register to be executed.

The *Start, Clear Counter, Fill Instruction* and *Execute Instruction* switches are interlocked with the mode selection buttons.

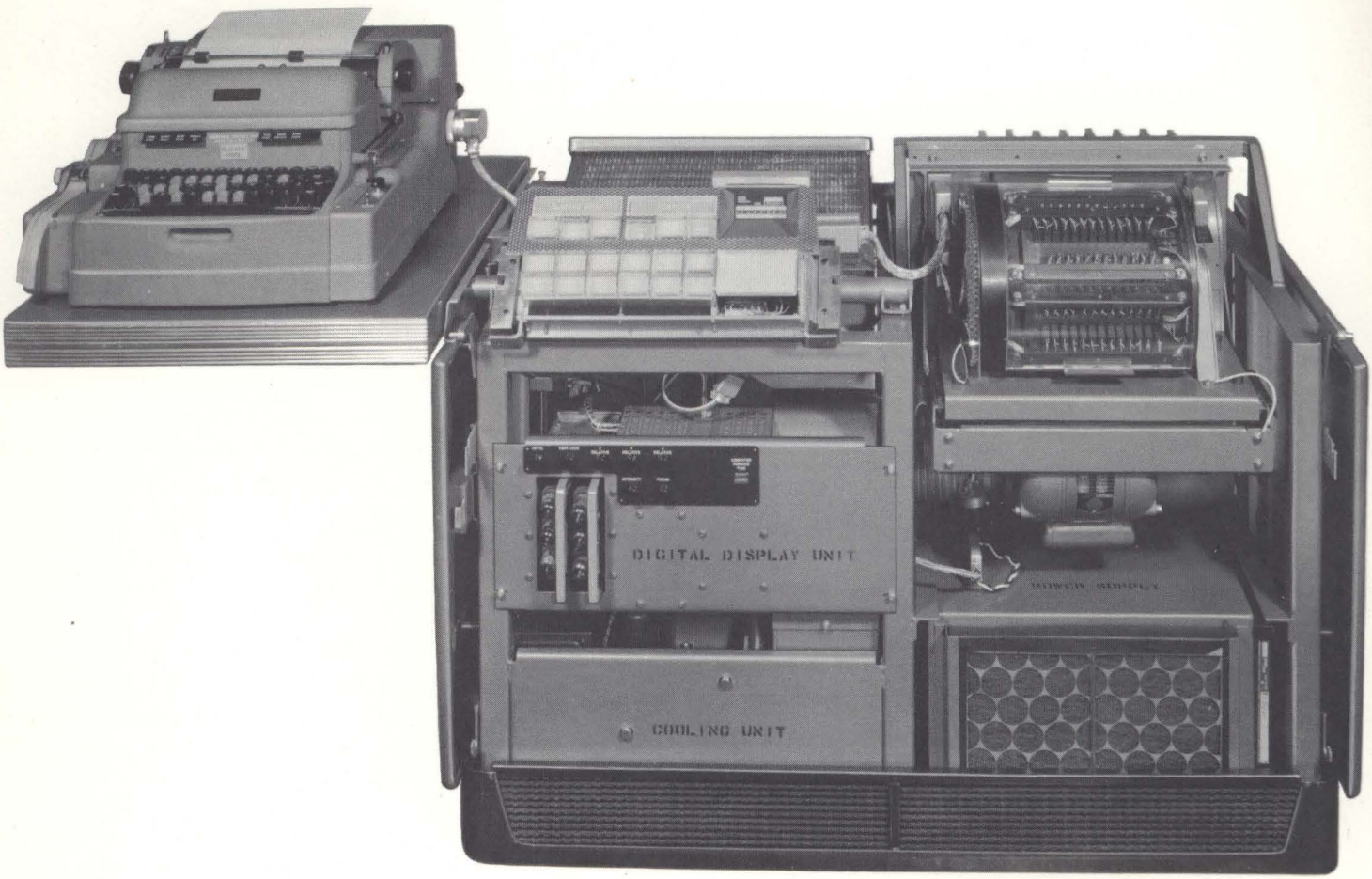
BREAK POINT. The five *Break Point* switches may be called into play by the address of a stop instruction in the program. This address may refer to any of these switches and cause the computer to ignore the stop at that point in the program if the button is on.

TRANSFER CONTROL. The *Transfer Control* switch gives the operator another means of manually controlling the machine. If there are two possible paths in the program and only a human can decide which path to follow, this switch may be used with a test instruction, to tell the machine which path to take.

BLOCKED STATE, COMPUTE. The *Blocked State* and *Compute* indicators tell whether the machine has stopped or is computing.

Lights under the switches indicate which buttons may be depressed at any time and show the operating status of the computer. As a result, the operator may focus more attention on his program.

LGP-30 *general specifications*



type

Serial, single address, fixed point, internally binary, stored program.

Number range: -1 to $+ (1-2^{-30})$

Neg. Number Representation: Complement

operation times

Total access time per instruction: 2 ms. min., 17 ms. max.

Transfer time: 1 ms. min., 17 ms. max.

Addition-subtraction time: .26 ms. (excluding access)

Multiplication-Division time: 17ms. (excluding access)

physical description

26" deep, 33" high 44" long, exclusive of typewriter and shelf.

Weight: 800 pounds.

Mounted on sturdy casters for portability.

Attractive, smooth, bronze and brown finish.

components

DRUM

Capacity: 4096 words in main memory
Word length: 32 bits including sign and spacer bit
Clock Freq.: 120 KC
Drum speed: 3600 RPM
No. of tracks main memory: 64
Recirculating registers: 3
Track spacing: .075″
Track width: .040″
Cell density: 100 bits per inch
Head to drum spacing: .001″ typical
Size: 6.5″ dia. x 7″ long
Computer: High stability aluminum alloy

HEADS

Librascope MH 10-A, standard, MH 10-R-1 Recirculating, MH 10-P, peripheral.

All heads are encapsulated for moisture resistance and dimensional stability. Low resistance windings and sintered ferrite cores with low capacitance assure stable operation.

TUBES

Total 113 (computer-type)
Diodes: Total 1450

LOGIC BOARD

A sandwich of 2 cards with 4 surfaces of etched wiring, containing all diode signal gating for the machine. This board contains 680 diodes and is quickly removable for check-out.

ETCHED CIRCUIT CARDS

34 cards of 12 different types, containing all tubes and associated components. Easily removable for maintenance. Card extenders are available for dynamic tests.

INPUT-OUTPUT

An electric typewriter with paper tape punch and reader and standard keyboard for manual entries in decimal form. Tape may be prepared while the computer is executing a program. Speed: 10 characters per second. 6 channel PT

POWER

Full: 1500 W from 115V 60 cycle, single phase line.
Standby: 35 W

Internal regulation of all voltages against power line variation. Warmup stage minimizes thermal shock to tubes. Self-contained blower directs filtered air over cards and logic board to insure long component life.

LGP-30

The LGP-30 is a product of the Royal Precision Corporation, Port Chester, New York.

The Royal Precision Corporation has been formed by the General Precision Equipment Corporation and the Royal McBee Corporation in order to combine the facilities of both organizations for the purpose of developing, manufacturing and marketing electronic data processing equipment.

The Royal Precision Electronic Computer (LGP-30) is manufactured by Librascope, Inc., Glendale, California, a subsidiary of General Precision Equipment Corporation and it is marketed and serviced through the nationwide distribution facilities of the Royal McBee Corporation. For additional information write to:

ROYAL McBEE CORPORATION
WESTCHESTER AVENUE
PORT CHESTER, N. Y.

RP2B — 735