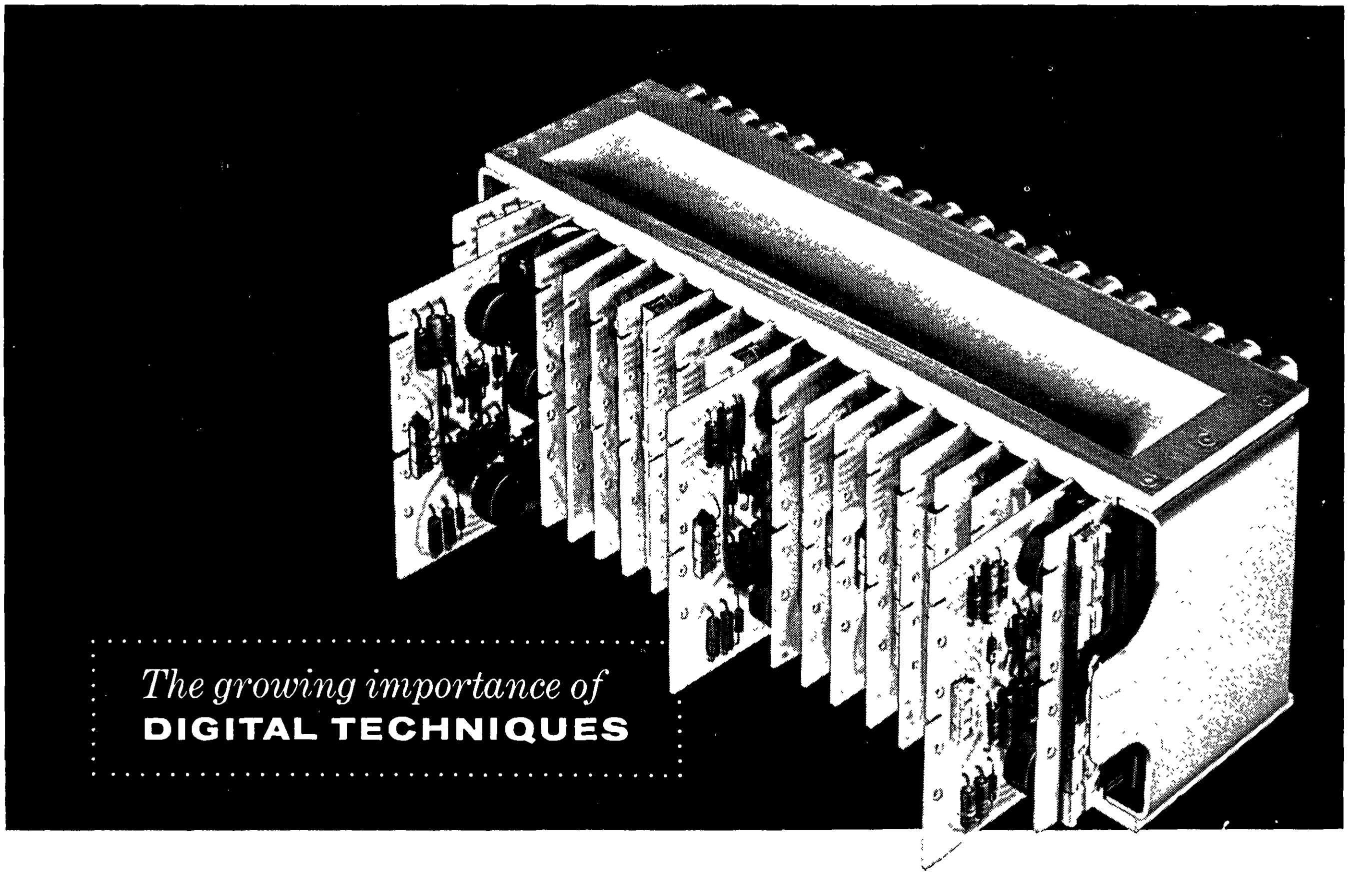
COMPUTERS
AND
AUTOMATION

CYBERNETICS • ROBOTS • AUTOMATIC CONTROL

Vol. 6
No. 5

May
1957



As recently as ten years ago it was just becoming evident that digital techniques in electronics were destined to create a new and rapidly growing field. Today, incorporated in electronic computers and other equipment, they constitute one of the most significant developments in scientific computation, in electronic data processing for business and industry, and in electronic ~~control systems~~ for the military. In the near future they are expected to become a major new factor in industrial process control systems.

The digital computer for scientific computation is becoming commonplace in research and development laboratories. Such machines range from small specialized units costing a few thousand dollars, to large general purpose computers costing over a million dollars. One of these large computers is a part of the Ramo-Wooldridge Computing Center, and a second such unit will be installed the latter part of this year. The digital computer has not only lightened the computation load for scientists and engineers, but has made possible many calculations which previously were impracticable. Such computers have played a major role in the modern systems engineering approach to complex problems.

Electronic data processing for business and industry is now well under way, based on earlier developments in electronic computers. Data processors have much in common with computers, including the utilization of digital techniques. In this field, teams of Ramo-Wooldridge specialists are providing consulting services to a variety of clients on the application of data processing equipment to their problems.

The use of digital techniques in military control systems is an accomplished fact. Modern interceptor aircraft, for example, use digital fire control systems. A number of Ramo-Wooldridge scientists and engineers have pioneered in this field, and the photograph above shows a part of an R-W-developed airborne digital computer.

These, then, are some of the aspects of the rapid growth which is taking place in the field of digital techniques. Scientists and engineers with experience in this field are invited to explore openings at The Ramo-Wooldridge Corporation in:

- Automation and Data Processing
- Digital Computers and Control Systems
- Airborne Electronic and Control Systems
- Guided Missile Research and Development
- Electronic Instrumentation and Test Equipment
- Communication Systems

The Ramo-Wooldridge Corporation

5730 ARBOR VITAE STREET • LOS ANGELES 45, CALIFORNIA

COMPUTERS AND AUTOMATION

CYBERNETICS • ROBOTS • AUTOMATIC CONTROL

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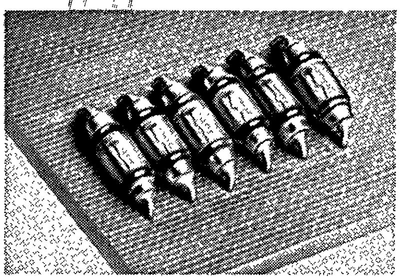
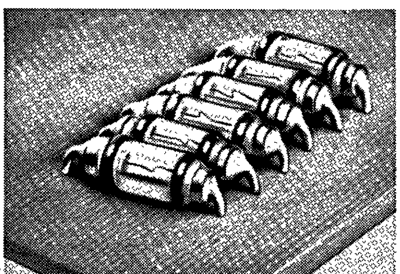
New Sylvania package offers

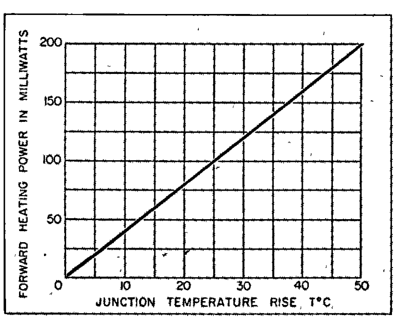
Maximum Dissipation in Miniature Diodes



Cooler operation resulting from higher dissipation of Sylvania glass-to-metal miniature diode permits closer printed board spacing for maximum savings in space.



Right angle bending of leads for printed board insertion does not affect the diode body since metal-to-glass design avoids chipping or cracking.



Typical dissipation curve of the Sylvania glass-to-metal diode.

Actual comparison of Sylvania miniature diodes with all-glass miniatures shows that the Sylvania metal-to-glass package design results in greater dissipation. As a result, cooler operation can extend diode life and improve product dependability and performance. Diodes can be banked closer on printed circuit boards for maximum space savings.

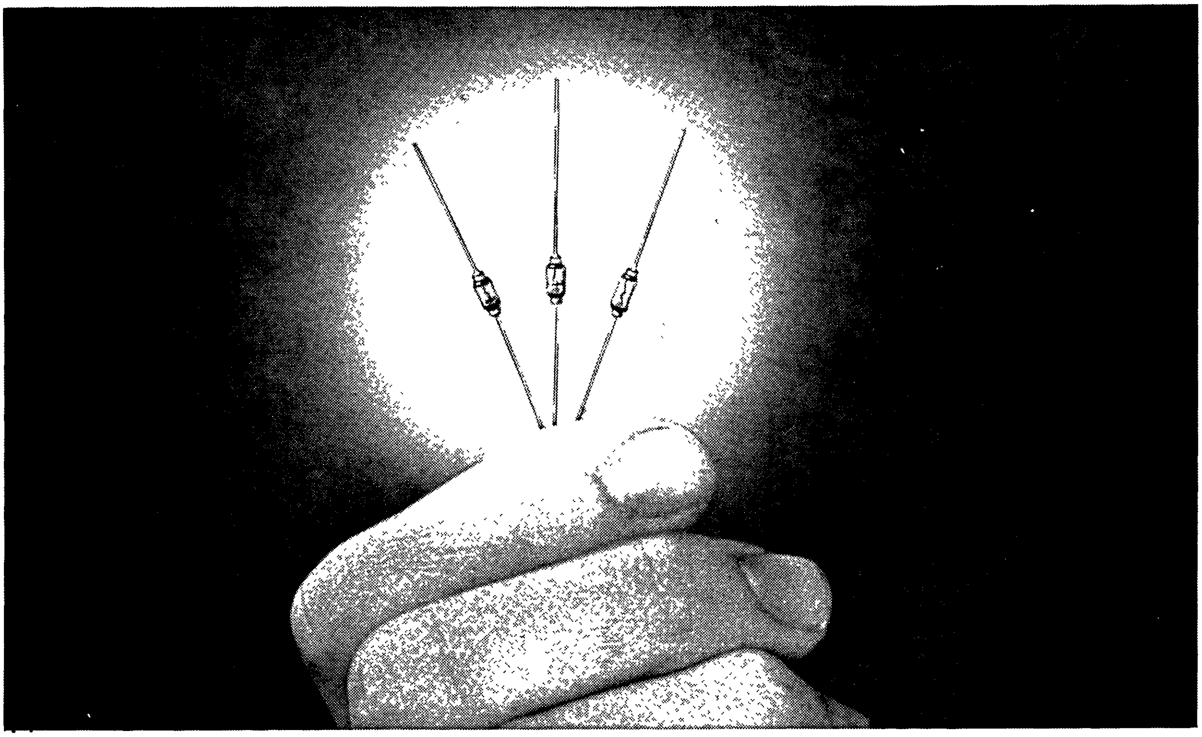
Metal-to-glass package offers other important advantages. The diode cartridge is assembled *before* installation of the whisker and die—avoiding excessive heating. In addition, right angle bending of the leads for printed board insertion does not result in chipping or cracking of the diode body.

Sylvania offers a complete line of miniature diodes in the glass-to-metal package. The package meets the standard RETMA outline of .105″ maximum diameter and .265″ maximum overall length. Write for complete details.

SYLVANIA

Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Bldg., Montreal

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY



ELECTRICAL CHARACTERISTICS OF SYLVANIA MINIATURE DIODES AT 25° C

Type	Minimum Forward Current at 1 volt	Maximum Reverse Current	Minimum Peak Inverse Voltage (0 dynamic impedance)	Maximum Forward Voltage	Minimum Reverse Resistance	Maximum Reverse Recovery @ 0.3 u sec (Note 3)	Stability
IN67A	4 ma	50 ua @ −50 volts 5 ua @ −5 volts	100 volts				
IN90	5 ma	750 ua @ −50 volts	75 volts				
IN98	20 ma	100 ua @ −50 v 8 ua @ −5 v	100 v				
IN126	5 ma	850 ua @ −50 v 50 ua @ −10 v	75 volts				
IN127	3 ma	300 ua @ −50 v 25 ua @ −10 v	125 volts				
IN128	3 ma	10 ua @ −10 v	50 volts				
IN191	5 ma	Note 1	Note 1				
IN198	4 ma (5 ma @ 75° C)	50 ua @ −50 v (Note 2) 10 ua @ −10 v	100 volts				
IN631				3.5 v (Note 4)	500 kohms (Note 5)	500 ua	Note 7
IN632				1 V If = 7 ma	500 kohms (Note 5)	800 ua	Note 7
IN633				1 V If = 125 ma	500 kohms (Note 6)	1650 ua	Note 7
IN634	50 ma	45 ua @ −45 v 100 ua @ −100 v	115 volts				
IN635	50 ma	175 ua @ −150 v	165 volts				

Note 1: For type IN191 at 55° C the reverse resistance will be 400 ohms or greater between −10 and −50 volts when swept from 0 to −70 volts at a 60 cycle rate.

The reverse recovery time will not exceed 0.5 usec at 700 *ua* or 3.5 usec at 87.5 *ua* of current when rapidly switched (at a 60 cycle rate) from +30 *ma* forward current to −35 volts.

Note 2: For type IN198 at 75° C the maximum reverse current at −50 volts is 250 *ua* and at −10 volts is 75 *ua*.

Note 3: a) Forward current exposure = 5 *ma*. b) Reverse test voltage = 40 ±2 volts. c) DC circuit resistance = 2000 ohms.

Note 4: Peak measurement with half sine wave of 50 *ma* peak current, 0.1 usec pulse width, and 100 kc pulse repetition frequency.

Note 5: Minimum resistance in thousands of ohms when E/I characteristic is swept at 60 cycles from 0 to −70 volts and resistance slope observed between −10 and −60 volts.

Note 6: Minimum resistance in thousands of ohms when E/I characteristic is swept at 60 cycles from 0 to −100 volts and resistance slope observed between −20 and −90 volts.

Note 7: Additional control measurements are made for reverse current hysteresis, reverse current drift, and flutter.

THE EDITOR'S NOTES

BARRIERS TO COMMUNICATION

I.

The Computation Laboratory of Harvard University held "An International Symposium on the Theory of Switching", April 2 to 5, in Cambridge, Mass. As the conference began, Dr. Howard H. Aiken, Director of the Computation Laboratory, read some cables. The first one was from Dr. Michael A. Gavrilov, Professor, Doctor of Technical Sciences, Academy of Sciences, Moscow, U. S. S. R., saying that illness prevented him from coming; his paper was "Investigation of Switching Theory in the Soviet Union". The second cable was from the Institute of Mathematical Machines, Academy of Sciences, Prague, Czechoslovakia, saying "Svoboda can not come"; Dr. Antonin Svoboda, Director of the Institute, was to give a paper, "Some Applications of Contact Grids". Dr. Aiken said that the other speakers from the U. S. S. R. (G. N. Povarov, Academy of Sciences, Moscow, whose paper was "A Mathematical Theory for the Design of Contact Networks"; Alexander G. Lunts, Associate Professor of Mathematics, Leningrad Electrotechnical Institute, Leningrad, whose paper was "Network Equivalent Transformations by Means of Characteristic Functions"; and V. N. Roginskii, Senior Research Associate, Academy of Sciences, Moscow, whose paper was "A Graphic Method for the Synthesis of Contact Multipoles") had not been heard from, and had not arrived at the conference. He expressed the regret — his own and of all those present — that none of these welcome scientists from the U. S. S. R. and Czechoslovakia had been able to come; and he hoped that Dr. Gavrilov's illness was not contagious. Dr. Aiken added that the texts of all papers had been received, would be read at the scheduled place in the program, and would be published; but that it was a great pity that discussion of questions with the authors could not take place.

We think we speak for all computer people when we say we also deeply regret political considerations spreading contagiously into scientific fields. We cannot see any earthly use to these stupid barriers to scientific communication. We are all of us human beings jointly pursuing scientific search to find out the secrets of nature.

II.

But this kind of barrier is not the only kind of a barrier. I thought as I walked around the Symposium, and looked at a great many new faces, how much I might have in common with many of them, if only I had a short cut for the first five minutes of conversation — when one decides whether or not "this man is interesting to me; we should talk together".

So far, the best form of communication at any computer meeting seems to be the cocktail party: no one sits down; everyone is mobile; you can wander around, say many hellos, introduce many people, and be introduced to many.

But there ought to be much better techniques of communication at computer meetings: (1) The tag which you wear at a meeting should show: your name; your organization; <u>your main interests</u>. This would give a wonderful starting point. (2) In your pocket you should have a thumbnail sketch of yourself, a "Who's Who" report, — so that while you read your new acquaintance's, he can read yours.

If computer people suffer from lack of communication, we have mainly ourselves to blame: we are supposed to be experts in information handling, information engineers!

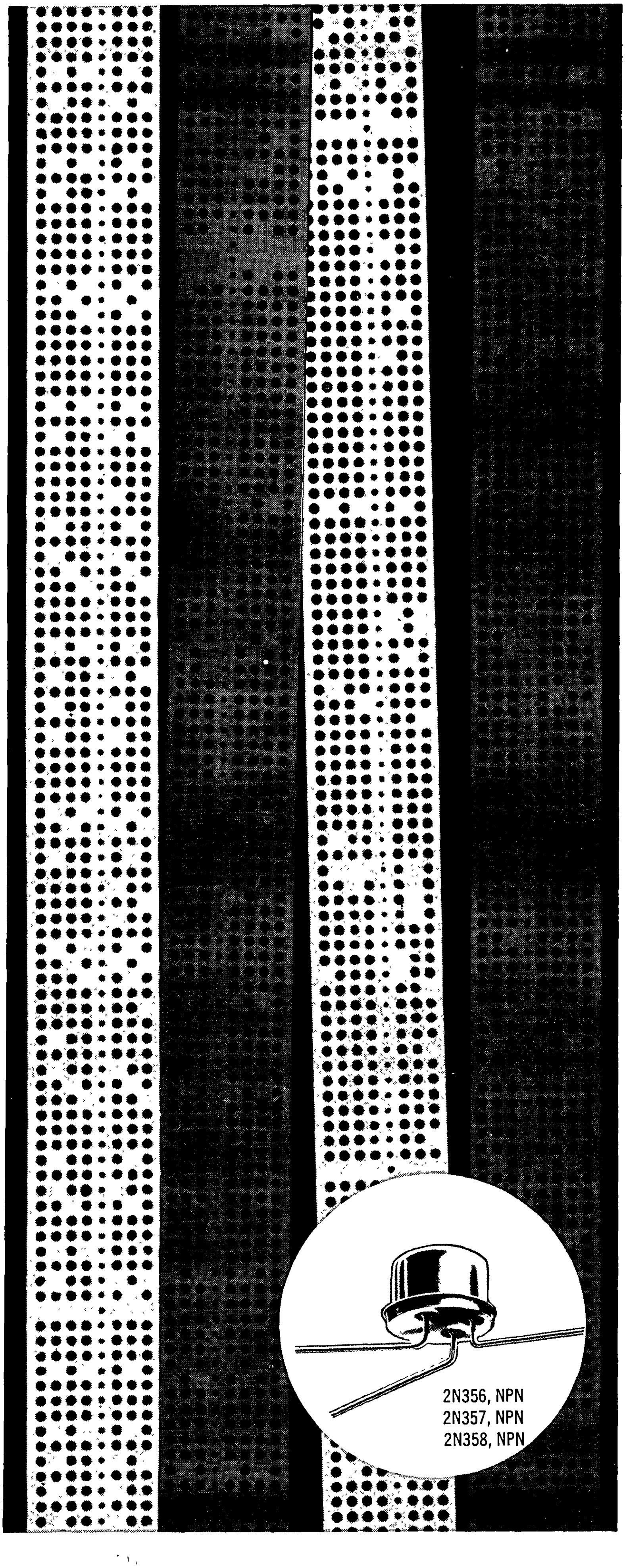
* —————— * —————— *

NEW PRODUCTS AND IDEAS

* —————— * —————— *

INDEX OF NOTICES

Address Changes: If your address changes, please send us both your new and your old address (torn off from the wrapper if possible), and allow three weeks for the change.



General
NEW HI-SPEED NPN SWITCHING TRANSISTORS
Assures Computer Reliability

Computer engineers long seeking NPN transistors in applications requiring high current and fast switching will specify General Transistor's new 2N356, 2N357, and 2N358 for peak reliability.

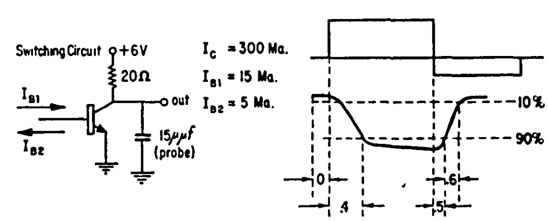
2N358: As developed by General, a typical switching speed of .4 of a microsecond at 300 milliamperes of collector current is possible with only 15 ma. of drive current.

The series resistance of these GT transistors. when conducting, is ½ ohm; the nonconducting series resistance is as high as 5 megohms with a result that approaches optimum efficiency at high current levels.

Computer manufacturers know they can depend on General's engineering and development as well as their quality and service. That's why GT is the largest supplier of transistors for computers.

2N358 CHARACTERISTICS

Parameter	Conditions	Min	Typical	Max
Collector-Base	Ic = 25μa	20V	30V	
Voltage	Vcb = 5V			5μa
Collector Cutoff	Ic = 300ma			
Current	Vce = .25V	20	30	50
D.C. Current Gain	Ic = 1ma		9mc	
Alpha Cutoff	Vcb = 5V			
Frequency	Ic = 1ma		9mc	



Write for GT's special NPN Computer Transistor Specifications Bulletin.

GENERAL TRANSISTOR CORP.

Jamaica 35, N. Y.—OLympia 7-9700
Cable: Transistor New York

COMPUTER MARKET SURVEY — REPORT NO. 1

Edmund C. Berkeley
Editor, "Computers and Automation"

INTRODUCTION

At the beginning of March, we mailed out to our subscribers in the United States and Canada a survey form, the main purpose of which was to make an estimate of the market for computer products and services. A copy of the survey form appears on page 40.

Approximately 2200 of these forms were mailed out; and as of the middle of April, about 200 forms, or 9 percent, had been returned. The replies contain interesting, important, and extraordinary information, showing the nature and size of the current market for computing and data processing machinery. The replies will furnish the material for several reports to our readers, particularly after they have been carefully projected, industry by industry, to determine their probable implications.

In the meantime, we think that the interests of our readers will be best served if we publish a serial tabulation of a part of the raw data received for each reply. This is especially true because often in surveys the examples of the raw data are just as interesting as summaries of the data. The tabulation given below includes all replies except a few incomplete or inapplicable returns.

Each entry in the tabulation is important, because it represents a report by a subscriber of "Computers and Automation" (whose title in his organization has been indicated) who kindly took the trouble to send us in his estimate for the advantage of others. We express our appreciation to these subscribers of ours for sending us this information.

WHAT THE TABULATION CONTAINS

An explanation of the information in the table follows:

(1) Code. This code identifies the return, not the organization. Although the name of the organization was given on nearly every return, we cannot publish the name since it was requested "for statistical purposes" only.

(2) Type of Organization. This is self-explanatory.

(3) Size. Size is reported in number of employees, grouped. S stands for small size, 1 to 50 employees; M, medium size, 51 to 500 employees; L, large size, 501 to 5,000 employees; vL, very large size, over 5,000 employees.

(4) Recom., Title. Here is the report on the question "Do your recommendations affect purchases?", and the title of the person filling in the questionnaire. The purpose of this information is to give some indication of the probable authority of the estimate here reported.

(5) Products and Services. Here is the report on the question "What kinds of computer products and services does your organization buy or rent (or is considering buying or renting?"

Column (a) reports on "automatic digital computers".
Column (b) reports on "automatic analog computers".
Column (c) reports on "other computers"; the codes are as follows:
- S - simulators
- v - other data processing machines

Column (d) reports on "components"; the codes are as follows:
- D - Delay lines
- M - Magnetic tape devices
- T - Transistors
- O - Other components

Column (e) reports on "services"; the codes are as follows:
- P - comPuting services
- S - conSulting services
- O - Other services

(6) Likely Spending Next Five Years. This column reports on the question: "Can you estimate roughly and approximately about how much your organization is likely to spend on products and services in the computer field in the next five years?
Between__________and__________."

If a lower figure was given but no upper figure, we have inserted for the upper figure an amount equal to twice the lower figure. If this question was not answered, but the "likely spending" in the next twelve months was estimated, we have taken the one year figures and multiplied by five.

A ROUGH AND APPROXIMATE ESTIMATE OF THE MARKET FOR COMPUTER PRODUCTS AND SERVICES

The total of the figures in Column (6) of the tabulation, "Likely Spending Next Five Years", for the 201 cases in the sample, is "between $415,459,500 and $758,660,000," or rounding off, "between $400,000,000 and $750,000,000". In this sample, there are 70 cases not giving any figures; they have been added as zero; but let us ignore that in order to be conservative.

It is possible to take this total and multiply it by a factor F, and arrive at a rough and approximate estimate of the market for computer products and services. Everything however depends on the amount of the factor F.

The factor could be chosen as 10 or 11--the ratio of 2000 or 2200 to 200, but there are many reasons why this is incorrect and should not be done. (1) It is not necessarily true that the sample here is a representative sample; it is far more likely to be non-representative. (2) Examining the entries in the tabulation we can see that there is a heavy preponderance of replies from buyers of computers and systems. Buyers of components are hardly represented. Yet in order to make the computing systems shown above, there will have to be tremendous purchasing or manufacturing of components to go into them. This would tend to increase F. (3) There may be bias associated with returning the survey form. A number of subscribers to "Computers and Automation" could have said to themselves "Well, my recommendations would not affect purchase --this kind of questionnaire is not for me to fill out and return". This would tend to decrease F. And there are many more reasons.

But the factor F is almost certainly not less than 2. For it would be very hard to believe that a 9 percent sample has reported 50 percent of the market. Also it would be hard to believe that the factor F is much greater than 30; for it would be hard to believe that a 9 percent sample has reported only 3 percent of the market.

Suppose then that we temporarily apply a factor of 10, until the time when we have compared these reports more carefully and made industry by industry predictions. Then we wind up with a rough and approximate overall estimate of the computer market in the United States and Canada over the next five years: "between four billion and seven and a half billion dollars".

KEY TO SOME OF THE ABBREVIATIONS

acty	actuary
admn	administration, -or
anal	analyst, -is
apln	application, -s
chmn	chairman of committee
comp	computer, -ation
ctr	center
des	design
EDPM	electronic data processing machines
EE	electrical engineer, -ing
eng	engineering
eqpmt	equipment
flt	flight
gp	group
indir	indirectly
ins	insurance
ldr	leader
leg	legislation
meth	methods
oper	operations
orgn	organization
plng	planning
phys	physicist
poss	possibly
proc	procedures
procg	processing
prom	promotion
prgmr	programmer
rec	records
ref	reference
reg	regional
rep	representative
res	research
sci	science, -tist
sim	simulation
stat	statistician
sys	systems
tabg	tabulating

Tabulation 1

ESTIMATE OF COMPUTER MARKET --

SUMMARY OF REPLIES MARCH 8 TO APRIL 15

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
1B1	digital computing service	S	yes, dept director	v	-	v	-	-	-	-
1B2	reliability research	M	yes, div mgr	v	-	v	-	-	$ 75,000	$ 125,000
1B3	radar & radar data procg, special receivers, gen. electronics	L	yes, engrg consltnt	-	-	v	DMT	P	-	-
1B4	insurance	vL	yes, dir meth res	v	-	v	M	-	-	-
1B5	air transportation	vL	yes, dir res	v	-	v	TO	PS	2,000,000	4,000,000
1B6	custom designed processes and systems	S	yes, pres	v	-	v	M	PS	1,000	500,000
1C1	investment services	L	yes, div mgr	v	-	-	M	S	400,000	1,000,000
1C2	industrial instruments	L	yes, comptr supvr	v	v	-	M	-	1,300,000	1,500,000
1D1	electrical machinery	vL	yes, -	v	v	S	-	-	1,500,000	6,000,000
1D2	air conditioning	vL	yes, dir of proc	v	-	-	M	-	600,000	700,000
1D3	semiconductor devices	M	yes, gen mgr	-	-	-	O	-	-	-
1E1	oper res services	M	yes, sr res assoc	-	-	-	-	P	-	-
1F1	instruments	M	yes, staff engr	v	-	-	DMT	-	100,000	200,000
1F2	chemicals	vL	yes, engr	v	v	v	M	P	10,000,000	15,000,000
1F3	life insurance	vL	yes, sr res assoc	v	-	-	M	-	2,000,000	3,000,000
1G1	industrial instruments	L	yes, -	v	-	v	T	S	300,000	500,000
1H1	elecnc tube sales dept	-	- , analyst	-	-	-	-	-	-	-
1H2	electrical apparatus and eqpmt	vL	yes, consltnt	v	v	SO	MTO	-	25,000,000	35,000,000
1H3	chemicals	L	yes, mgr	v	-	v	M	-	500,000	1,000,000
1H4	heat transfer apparatus	L	yes, dept mgr	v	-	-	-	-	250,000	350,000
1H5	banking	L	yes, 2nd VP	v	-	-	-	-	15,000	2,000,000

Computer Market

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
1I1	banking services	L	yes, VP	v	-	-	-	-	$15,000	$2,000,000
1I2	banking	M	yes, res analyst	v	-	v	M	-	-	-
1J1	research	M	yes, div head	v	-	-	-	-	25,000	250,000
1J2	data procg machines	vL	no, -	v	-	-	-	P	-	-
1J3	computers, data procg eqpmt	-	no, applied sci rep	v	-	SO	M	PS	-	-
1K1	mfg surgical dressings	L	yes, supvr	v	-	-	-	-	250,000	400,000
1L1	consulting service	S	yes, mgmt engr	-	-	-	-	-	-	-
1L2	naval reactors	L	yes, mgr	v	-	-	M	P	5,000,000	8,000,000
1M1	retail chain apparel men & boys	M	yes, treas	v	-	-	-	P	50,000	60,000
1M2	detergents, shortening, margarine, dentifrice	vL	yes, sr sys analyst	v	-	-	-	-	250,000	750,000
1N1	banking services	L	yes, asst cashier	v	-	-	-	-	480,000	700,000
1N2	drugs, fine chemicals, pharmaceuticals	vL	yes, dept mgr	v	-	v	-	S	1,000,000	2,000,000
1O1	naval ship construction	vL	yes, CDR SC	v	-	v	-	-	8,500	60,000
1R1	service orgn (library)	L	yes, adm asst	v	-	v	-	-	-	-
1S1	printing & punched card services	L	yes, VP	v	-	-	-	S	150,000	200,000
1S2	office eqpmt	-	-, reg'l mgr	-	-	-	-	-	-	-
1S3	education & research	M	yes, asst prof	v	v	-	-	P	100,000	500,000
1S4	casualty, fire & marine insurance	vL	yes, mgr	v	-	-	M	-	2,500,000	3,000,000
1T1	electronic research	M	yes, acct mgr		-	-	-	-	2,500	5,000
1T2	oil & chemicals	-	yes, asst mgr	v	v	-	M	P	2,500,000	7,500,000
1T3	engrg development	S	yes, exec engr	-	-	-	DMTO	-	100,000	250,000
1T4	gen mail order	L	yes, comp ctr mgr	v	-	v	MO	P	2,500,000	5,000,000
1T5	textiles	vL	yes, -	v	-	v	-	-	-	-

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
1U1	research & development	M	yes, head math apln gp	v	v	–	M	PS	$1,000,000	$2,000,000
1U3	electrical wire & cable	L	yes, methods dir	v	–	–	M	–	500,000	1,000,000
1V1	elecnc digital computers	M	–, advt & prom mgr	–	–	–	M	–	–	–
1V2	textiles	vL	yes, mgr	v	–	–	–	–	200,000	250,000
1V3	maps	L	yes, sec chief	v	–	–	M	PO	3,000,000	10,000,000
1W1	valves	vL	yes, staff speclst	v	–	–	–	–	100,000	500,000
2B1	electronic eqpmt	M	yes, oper mgr	–	–	v	DMT	S	700,000	1,000,000
2B2	rayon, nylon, staple	L	no, mgr	v	–	–	MO	–	750,000	1,000,000
2B3	ord, A & S group, pension insurance	M	yes, asst VP	v	–	v	M	–	600,000	800,000
2B4	fire & casualty insurance	M	yes, VP	v	–	–	M	PS	–	–
2C1	shoe retail & mfg	M	no, IBM mgr	v	–	–	–	S	–	–
2C2	prototypes (miss & flares)	vL	no, anal	v	v	v	M	PS	–	–
2C3	computers	–	yes, reg mgr	v	–	–	–	–	–	–
2C4		–	yes, dir	v	–	–	–	–	–	–
2D1	petroleum	vL	yes, asst to mgmt	v	–	–	–	PS	2,000,000	4,000,000
2D2	aeronautical electronics systems	M	yes, VP	v	v	v	O	PS	500,000	1,000,000
2D3	test & eval'n aircraft arm systems	S	yes, supvsr mathn	v	–	v	MO	O	100,000	200,000
2D4	containers	vL	yes, dept mgr	v	–	–	–	–	500,000	625,000
2D5	aircraft	vL	yes, desn speclst	v	v	v	DTO	–	–	–
2E1	life, fire & casualty ins	M	yes, mgr	v	–	v	MT	–	600,000	800,000
2F1	ferro-alloys & metals	vL	yes, mgr	v	–	–	–	–	500,000	1,000,000
2G1	aircraft	–	–, chief	v	v	–	–	–	550,000	700,000
2G2	shoes	L	yes, tabg mgr	–	–	–	–	–	–	–
2G3	computers	L	yes, project supvsr	v	–	v	DMTO	PS	1,200,000	2,500,000
2G4	automobiles	vL	yes, anal	v	–	–	–	–	–	–

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
2G5	steel producer	vL	yes, supvsr	v	-	-	M	-	$875,000	$1,250,000
2H1	rubber, plastics, etc	vL	yes, mgr EDP	v	-	-	M	S	100,000	200,000
2H2	AEC installation	-	yes, comp supvsr	v	-	-	-	-	1,000,000	1,500,000
2J1	business machines	-	yes, devel engr	-	-	-	-	-	-	-
2M1	life insurance	L	no, assoc act y	v	-	-	M	-	600,000	750,000
2N1	transformers & components	S	yes, dir engrg	-	-	-	-	-	-	-
2N2	library service	M	yes, admn asst	-	-	-	-	-	-	-
2O1	business machines	vL	yes, head res dept	-	-	-	MTO	-	100,000,000	200,000,000
2O2	airplane missiles, reactors	-	yes, gen supvsr	v	v	-	M	-	35,000,000	50,000,000
2O3	airframes	vL	yes, EDPM supvsr	v	v	-	-	-	4,620,000	6,200,000
2O4	ordinary life insurance	L	yes, asst act'y	v	-	-	M	O	1,800,000	2,800,000
2P1	research (atomic energy)	L	yes, mathn	v	v	v	DMTO	PSO	5,000,000	7,500,000
2P2	life insurance	M	yes, asst compt	v	-	-	M	-	400,000	500,000
2P3	petroleum products	vL	yes, sr res phys	v	v	-	M	-	500,000	700,000
2Q1	life insurance	L	yes, data procg dir	-	-	v	O	-	240,000	300,000
2Q2	data redn systems	L	yes, -	-	-	-	MT	P	750,000	1,250,000
2Q3	pharmaceuticals	vL	yes, mgr mach rec div	v	-	-	O	-	-	-
2Q4	engrg, consltnt serv	M	yes, des engr	v	-	v	O	P	80,000	120,000
2S1	computers - component	-	poss, -	v	-	-	MO	PS	-	-
2S2	digital computers	-	-, -	-	-	-	-	-	-	-
2S3	steel	L	yes, mfr	v	-	-	M	-	2,000,000	2,500,000
2T1	railroad transportn	vL	-, asst engr valn	v		v	M	-	-	-
2T2	savings accounts	M	-, audit	v	-	-	M	-	-	-
2T3	basic agric & industl chemicals	L	yes, sys supvsr	v	-	-	O	P	180,000	200,000

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
2T4	dept store	L	yes, proj rep	v	-	-	-	P	$17,500	$225,000
2U1	pipe forgings, flanges, fittings	L	yes, sys analst	v	-	v	M	-	1,000,000	1,500,000
2U2	detect syst transistors elect comp	L	yes, data procg supvsr	v	v	v	-	-	700,000	1,000,000
2V1	leasing of tank cars	L	part, asst s & p	v	-	v	MO	-	500,000	1,000,000
2V2	insurance	L	yes, const	v	-	v	-	S	1,125,000	1,500,000
2V3	insurance	M	yes, mgr	v	-	-	M	-	300,000	500,000
2V4	admn fed leg re rail workers	L	indir, supvsr	v	-	-	M	-	-	-
2V5	medical & hospital care	S	no, asst med admn	-	-	v	-	-	-	-
2X1	nuclear consltg services	M	yes, dept head	v	v	-	-	P	100,000	500,000
2X2	research & devel	M	yes, sec mgr	-	v	v	MTO	PS	25,000	50,000
2X3	digital computing serv	S	yes, supvsr engr	v	v	v	T	PS	2,500,000	3,000,000
2X4	services to medicine	S	yes, pathol	v	-	-	MT	-	-	-
2X5	statistics	S	no, prgmr	v	-	-	M	-	-	-
2A1	radio, TV, hearing aids	vL	yes, supvsr tab dept	v	-	-	M	-	-	-
3B1	rocket engines	vL	yes, sr engr	v	v	v	M	-	2,500,000	5,000,000
3B2	designs	S	yes, EE	-	-	S	-	-	-	-
3B3	baked goods	-	yes, offc mgr	v	-	-	O	-	-	-
3B4	insurance underwriters	M	yes, data procg anal	v	-	-	M	S	1,750,000	2,500,000
3B5	data procg for geodetic div	S	no, mathn proj ldr	v	-	v	-	-	-	-
3B6	management education	M	yes, spec proj dir	v	-	-	-	PS	125,000	250,000
3C1	research & development	-	-, mgr math anal sec	v	v	-	M	P	3,000,000	5,000,000
3C2	data procg, comptg, math & stat res, surveys	S	yes, chief res sci	v	v	v	M	-	100,000	300,000
3C3	airplanes	vL	yes, actg supvsr	v	-	-	M	P	1,680,000	3,560,000
3D1	transportation service	vL	yes, sys dev chief	v	v	v	M	PS	5,000,000	10,000,000

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
3D2		-	no, sr prgmr		-	-	-	-	$300,000	$400,000
3D3	life insurance	L	partly, asst mgr	v	-	v	MO	-	2,000,000	2,500,000
3D4		M	yes, head flt sim lab	v	v	S	DMTO	-	3,000,000	5,000,000
3E1	agriculture	L	yes, mgmt anal	v	-	v	DM	O	1,300,000	1,500,000
3E2	answers	S	yes, data procg dir	v	-	v	-	P	375,000	500,000
3E3	logistics	S	yes, DEP-LDPDO	v	-	-	-	-	4,000,000	6,000,000
3E4	research & development	M	yes, VP	-	-	SO	DMTO	P	500,000	1,000,000
3F1		-	-, ref librarian	v	v	SO	DMT	-	-	-
3G1	insurance	M	yes, mgr	-	-	v	M	-	-	-
3G2	banking	L	yes, VP	v	-	v	M	-	1,500,000	2,000,000
3G3	aluminum extrusions & steel sash	L	yes, compr mgr	v	-	v	-	-	-	-
3H1	none, general composing function	M	yes, mgr	v	-	v	M	S	200,000	3,000,000
3H2	digital computers	M	yes, lab adm	-	-	DMTO	-	-	-	-
3H3	life insurance	M	yes, coordtr	v	-	-	-	-	225,000	275,000
3J1	digital computers	vL	no, sci rep	-	-	-	-	-	-	-
3J2	digital computers & acctg machines	vL	no, assoc engr	-	-	-	-	-	-	-
3J3	petroleum products	vL	yes, chmn	v	v	-	M	S	3,000,000	4,000,000
3J4	insurance	L	yes, supvsr elecncs	v	-	v	M	-	800,000	900,000
3J5		-	potentially, partner	-	-	-	-	-	-	-
3M1	electronic	L	yes, data proc mgr	v	-	-	-	-	-	-
3M2	casualty insurance	vL	yes, mgr	v	-	v	-	-	250,000	1,000,000
3M3	airplanes	vL	yes, mgr	v	v	S	M	S	7,000,000	10,000,000
3N1	ship construction and repairs	vL	yes, asst comptrlr	-	-	v	M	P	5,000,000	10,000,000
3N2	insurance	L	yes, supvsr	-	-	v	M	-	-	-
3O1	adding machines, cash registers, data proc sys	L	no, sr sys engr	-	-	-	MT	-	-	-

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
302	aircraft & assoc eqpm	-	yes, engr	v	-	v	DMTO	-	-	-
303	natural gas transmission	L	yes, data proc dir	v	-	-	M	-	$2,000,000	$3,000,000
3P1	crude oil & refined prods	vL	yes, supvsr	v	-	v	-	-	2,500,000	3,000,000
3Q1	truck transportation	L	yes, dir acctg	v	-	v	-	-	250,000	500,000
3Q2	telephone service	vL	no, sr engr	v	-	v	T	PS	-	-
3Q3	personnel research	M	yes, anal stat	v	v	-	M	-	150,000	300,000
3Q4	engines & accessories	M	yes, gp ldr	v	v	v	-	S	400,000	1,000,000
3S1	electronics & research	L	yes, techl staff	v	v	SO	MT	-	-	-
3S2	research	L	no, asst mathn	v	-	-	-	-	-	-
3S3	research for air force	L	yes, dept chief	v	v	v	TO	-	3,000,000	6,000,000
3S4	research & techl training	L	yes, -	v	-	v	MTO	-	10,000,000	20,000,000
3S5	compr systems	-	-, sys anal	-	-	-	-	-	-	-
3T3	state government	vL	yes, techn tabg sys	v	v	v	MO	P	5,000,000	10,000,000
3T4	compensation insurance	L	yes, div chief	-	-	-	-	-	-	-
3T5	petroleum products	vL	yes, chmn	v	-	v	TO	PS	500,000	5,000,000
3U1	computer services	S	yes, pres	v	v	S	-	PS	50,000	75,000
3U2	core memories, matrices, buffers, data procg sys	M	yes, VP	-	-	v	MTO	S	10,000,000	25,000,000
3V1	pharmaceuticals	L	yes, asst chief acctnt	v	-	-	M	PS	1,000,000	2,200,000
3V2	personnel research	S	no, psychst	v	v	-	-	P	2,000,000	2,500,000
3X1	written communications	vL	no, div rep	-	-	-	-	-	-	-
4B1	electronic & nuclear R & D production	M	yes, head data procg	v	v	SO	MTO	S	3,000,000	5,000,000
4B2	military & industrial	L	yes, chief engr	v	v	-	DMTO	PS	-	-
4C1	research	L	yes, head comp lab	v	v	-	-	-	-	-
4C2	airplanes	vL	no, res engr	v	-	v	-	-	5,000,000	10,000,000

Computer Market

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
4C3	electric utility	L	yes, sys anal engr	v	v	SO	v	O	$240,000	$480,000
4D1		-	yes, supvsr	v	-	v	-	-	-	-
4D2	aircraft mfg	vL	yes, gp ldr compg	v	v	v	MO	-	600,000	1,500,000
4D3	electrical apparatus	vL	yes, mgr	v	v	v	M	-	2,000,000	3,000,000
4D4	aircraft	vL	no, res engr	v	v	-	-	S	-	-
4D5	aircraft	vL	no, prgmr	v	v	SO	-	-	50,000,000	100,000,000
4E1	technical college	vL	no, ref libr'n	v	-	-	-	-	-	-
4F1	data procg serv, consltg serv	S	yes, owner	-	-	v	MTO	-	20,000	60,000
4F2	petroleum research	M	yes, chem engr	v	v	-	M	O	700,000	900,000
4G1	communication equipment	vL	yes, mgr purchg	-	-	-	DT	-	-	-
4H1	computers	M	yes, -	v	v	SO	-	SO	15,000,000	30,000,000
4K1	el. aircraft power systems	L	yes, staff engr	v	v	-	M	P	100,000	300,000
4L1	training of students	S	yes, head dept EE	v	v	-	-	P	-	-
4N1		M	yes, chief res & plng	-	-	v	MO	-	2,500,000	3,100,000
4N2	credit information	M	yes, exec mgr	v	-	-	-	-	100,000	500,000
4N3	business consultants	M	yes, -	-	-	v	-	-	-	-
4O1	telephone service	vL	yes, supvsr	v	-	v	-	-	15,000,000	20,000,000
4P1	instruction, res services	S	yes, asst prof	v	v	v	MTO	PS	300,000	600,000
4Q1	banking services	L	yes, AVP	v	-	v	M	S	500,000	2,000,000
4S1	data procg eqpmt	-	no, meth anal	v	-	v	-	P	-	-
4S2	antenna couplers, spec purpose computers	L	no, serv engr	-	-	-	DMT	-	-	-
4S3	aircraft components	vL	yes, sys anal	v	v	SO	M	-	10,000	40,000
4T1	contractor to AEC	vL	yes, div supvsr	v	v	SO	DMTO	PSO	-	-
4T2	airborne analog comptr	L	yes, sec head	-	v	-	T	P	-	-

(cont'd on page 44)

NEW PRODUCTS AND IDEAS

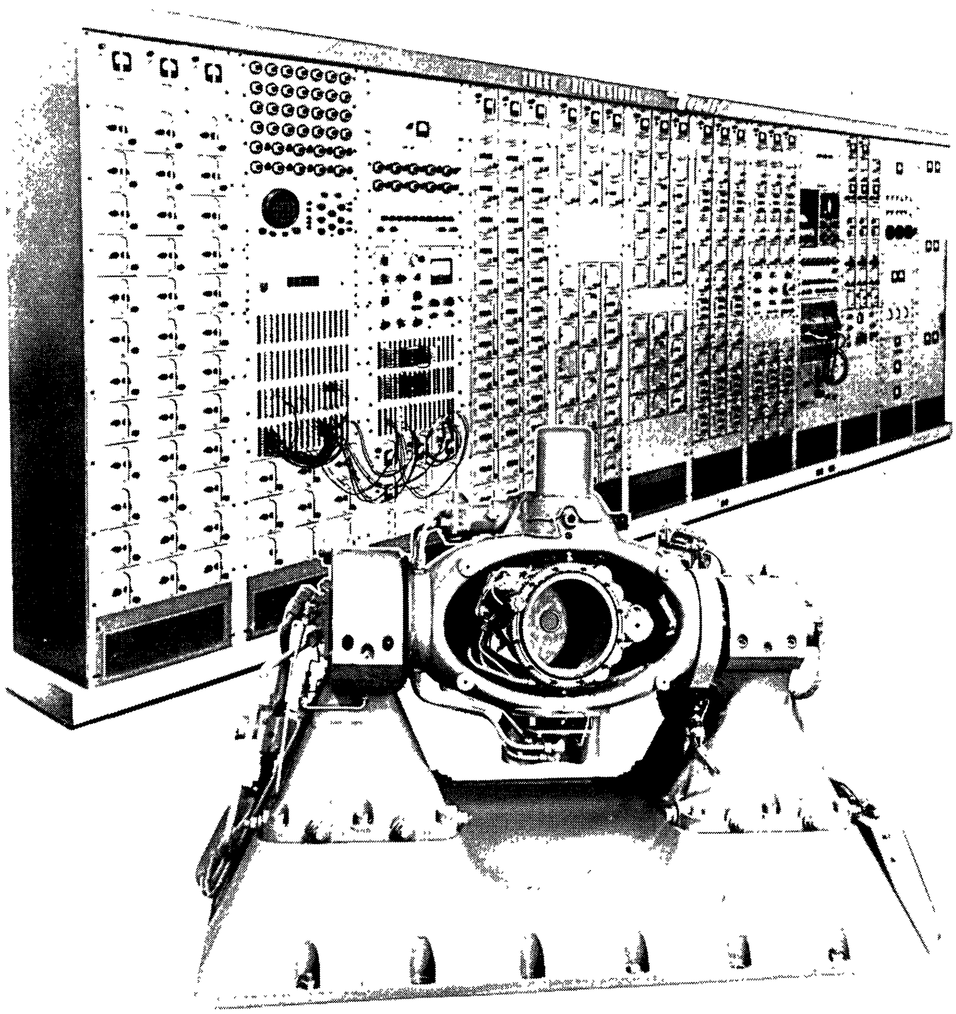
A THREE-AXIS SIMULATOR FOR CONTROLLED FLIGHT TEST OF AIRBORNE SYSTEMS

Bendix Computer Division
Los Angeles, Calif.

A new simulator is resulting in faster and more efficient testing of controls and guidance systems for missiles and aircraft. It is comprised of a 3-axis flight table and a precise analog simulator control unit; it reduces or eliminates the need for expensive trial flights in the evaluation and de-bugging of airborne systems.

Tests can be conducted with angular motions at accelerations and velocities programmed into the computer. The three gimballed assembly, mounted on a massive, vibration absorbing base, can be moved outdoors for line-of-sight tracking simulation of missile guidance systems. It produces the motions of roll, pitch and yaw through precision hydraulic servos.

The 3-axis simulator's electronic section contains its own analog computer, designed to exactly match the requirements of the system. The hydraulic supply is also included, eliminating the need for auxiliary movement.



The flight table specifications follow:

Maximum acceleration, with 50 lbs. load mounted on the table, in radians per second: roll, 2500; yaw, 500; pitch, 500. Maximum velocity, in radians per second: roll, 50; yaw, 15; pitch, 15. Altitude range: continuous on all gimbals. Frequency for 90 degree phase shift (with the same load as above), in cycles per second: roll, 100; yaw, 45; pitch, 45.

A NEW RADAR DEVICE FOR CORRECTED MAPPING

Fairchild Controls Corp.
Syosset, Long Island, N.Y.

A novel device which promises to inaugurate a new era in the use of radar for accurate mapping and charting has been completed. The instrument has been named the "Radar Restitutor"; it was invented, designed and fabricated by the Electronics Division of Fairchild Controls Corporation, a subsidiary of Fairchild Camera and Instrument Corporation.

Photographs of radar displays are not normally true maps since they contain many distortions and inaccuracies. This makes such photographs unsuitable for measuring distances between different points on the ground. The Radar Restitutor automatically computes the errors which give rise to the distortions present in the radar photography, and it produces a new photograph on which every ground object is accurately located. The photographs produced by the Restitutor are then used in the compilation of maps.

The chief distortion on the original radar photographs is caused by the fact that radar records the distance between the radar station and an object, and for airborne radar sets this means that the slant distance is recorded. For mapping purposes, though, it is necessary to know the ground distance between the point directly under the aircraft and the ground object. Another source of error is the fact that an airborne radar is continually moving, while the radar display does not take this motion into consideration. The Restitutor not only computes these distortions but several additional distortions as well, and positions the ground object at the corrected coordinates on the new photograph which it produces.

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LATTICE NETWORKS FOR DIGITAL STORAGE

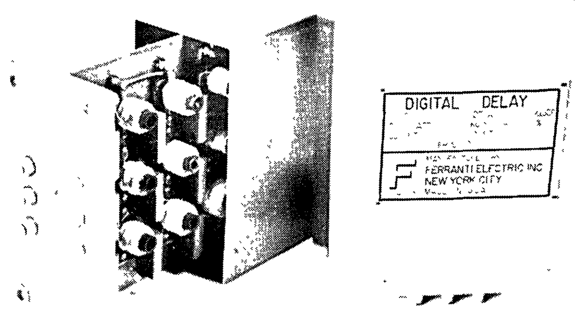
R. H. Davies
Ferranti Electric Inc.
New York 20, N.Y.

To the Editor:

Following is a brief description and a photograph of a new type of lattice network which we have developed for use in digital memory stores. We trust you will find this item sufficiently interesting for publication in the "New Products" section of your magazine.

These Lattice Networks for digital storage consist of a novel type of lumped constant electromagnetic network specifically developed and designed for digital storage. It uses only 1.2 elements per bit, and provides highly stable characteristics without extreme tolerances in the individual elements.

Hermetically sealed units can be supplied for any capacity up to 30 bits at digit rates up to 5 megacycles, for satisfactory operation over a temperature range of - 20°C to + 70°C. The units provide an extremely economical and compact form of storage in this capacity range, and can readily be grouped for serial or parallel operation with rapid access.



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A NEW IDEA IN COMPONENT SUPPLY

V. Guignon
Great Neck, N.Y.

In 1952, a new idea in supply of electronic components was started. The idea was simple but had never been tried; it was to gather under one roof a maximum of ten important lines of components -- no more --, to know everything possible about those ten lines, and to stock amply every item manufactured within those lines. Users could then count on sufficiently large stock in the distributor's hands to have their orders delivered to them in hours instead of weeks. Any engineer in charge of producing equipment to meet a deadline knows well that a bottleneck in supply is just as serious as any other kind.

Now, in 1957, the company, Schweber Electronics, Mineola, N.Y., has grown to 30 persons,

(cont'd on page 41)

RELIABILITY IN BUSINESS AUTOMATIC DATA PROCESSING

Herbert T. Glantz
John Diebold & Associates, Inc.
New York, N. Y.

(Based on a talk delivered February 27, 1957 at the Western Joint Computer Conference
Los Angeles, California)

Introduction

Throughout the past few years a great deal of study has been devoted to analyzing the different characteristics and requirements of scientific and commercial data processing systems. Although early general agreement was reached on the fact that such systems were different, the exact cause and nature of these variations has not yet been clearly defined. Equipment manufacturers attempted to resolve this difficulty by designing two distinct "lines" of computer models. In some instances these manufacturing distinctions have become blurred with usage, with the result that a Remington Rand Univac is utilized for engineering calculations, while an IBM 704 is applied to payroll preparation. But, in the main, this dichotomy of design and application is being effectively preserved.

Dr. Jay Forrester, the former Director of MIT Project Whirlwind, has characterized the chronology of electronic computation as falling into three distinct phases. Beginning in 1945, an intensive amount of research was devoted to investigation of the physical possibility of building electronic digital computers. The early studies of computer logic and circuit design were conducted almost entirely by various engineering universities. By 1950 it was apparent that the basic problems could be solved and that electronic computation would become a reality. Shortly afterwards, the major portion of research activity was shifted to the application of these machines to various problems. The second phase of the history of electronic computation was devoted to computation in the fields of engineering and science, as the first large-scale digital computers began to appear in the universities and aircraft companies. In 1955 the emphasis of machine applications research began to switch from engineering to commercial problems. This trend marked the entry into the third and perhaps the most vital phase of development of electronic computation.

As the problem of utilizing electronic equipment for business applications was approached, it became apparent that there were major differences in the requirements of this new area. The early studies devoted to this problem concentrated on seemingly obvious operational variations. Business problems called for vast amounts of input-output data, while scientific problems required lengthy and involved internal calculations. Thus, in short order a convenient categorization grew up:

Engineering and Scientific Applications: Small volume of input-output data; large amounts of complex internal calculations.
Commercial Applications: Large volumes of input-output data; small amounts of simple internal calculations.

Although this fairly arbitrary and sweeping classification proved adequate for early needs of the industry, an increasing sophistication in computer usage has tended to obscure these demarcation lines. It has become increasingly evident that such operational differences do not provide an adequate representation of the two different systems.

If one considers instead the respective functional purposes of scientific and commercial systems, a striking contrast may be observed. Scientific data processing installations may be regarded as self-contained systems which function only to satisfy the dictates and requirements of the parent organization. Thus, in a broad sense, all input data originates within the system proper; all computations are determined by the needs of the overall organization; and the timing, quantity, and amount of output information is again dictated by the requirements of the system itself.

Commercial data processing systems, on the other hand, must inevitably exist and perform their functions in constant relationship with the environment of the business world at large. This relationship, which dominates both the design and performance of business systems, is notably evidenced in three ways. The mass of data entering the system originates externally and is to a large extent uncontrolled in format, timing, content, and accuracy. The calculations that are performed are frequently regulated by the rules of outside agencies such as the S.E.C., I.C.C., and the Bureau of Internal Revenue. Finally, the daily deadlines that must be satisfied are generally determined by an essentially indifferent environment and are frequently unyielding and seemingly unrealistic.

Accordingly, whereas a scientific data processing system exists and operates to satisfy its own needs, commercial systems must function in large measure to satisfy requirements imposed from outside the system.

The Design of Business Systems

Business systems are growing increasingly more complex as their range of applications expands to cover more demanding and more intricate areas. A functioning commercial data processing system includes a variety of information handling components, human, mechanical, and electronic, which are linked together by an overall communications network. The term "integrated data processing" has gradually come to be accepted as a generic description of the workings of such systems.

The design of these systems has created a striking opportunity for the business world. We are now able to conceive of all routine daily operations of a company being controlled and directed by an automatic system. Automatic process control is already a familiar occurrence in the chemical and petroleum industries. We are on the verge of applying similar concepts to a number of commercial enterprises. The underlying theme in such systems is automatic control of business operations including a feedback loop for the correction of errors. At the same time, the managing executive is to be provided with information that will allow him to exercise control over entire company policy on the basis of reliable and timely data.

However, in painting this picture of successful office automation we have passed over a number of evidently dangerous pitfalls. For as automatic systems exercise a greater amount of control and direction, one must place a correspondingly greater emphasis on their operating reliability. Intermittent or periodic failures in such systems can wreak more havoc than is to be gained from long intervals of reliable operation. The increased complexity of these systems introduces more components that are liable to failure and, due to their varying interrelationships, introduces a greater degree of difficulty in isolating and replacing the faulty elements. Many systems engineers become so enamored of possible accomplishments that they tend to overlook the question of system reliability and the implications of component failure.

As an illustration of the problems that are inherent in the operation of business data processing systems, I should like to briefly discuss two systems that our organization has designed for commercial organizations. In both cases we have completely restructured the data processing operations of the companies involved. In both cases, although substantial dollar savings were accomplished, our primary aim was to have the data processing system provide more effective aid to the sales organization and to top management of the company. In both cases this was effected by centralizing the data processing elements and by utilizing extensive communications networks.

A Stock Brokerage House

"X" is one of the largest stock brokerage houses in the country. Their main volume of business originates on the West Coast where they maintain a number of branch offices. One of the principal requirements of competitive existence in the brokerage field is rapid fulfillment of customers' orders, and requests for sample prices, or "quotes". Since most of the clients' trading is done on the floor of the New York Stock Exchange, the company utilizes an extensive private wire system to link the branches with the Eastern trading center. It is not unusual for an order to originate in Los Angeles, be flashed to New York, be executed on the Exchange, and be confirmed back to Los Angeles in a matter of two or three minutes.

The system that we have designed for this firm includes an automatic teletype switching center on the West Coast and a Data Processing Center in New York. The data processing center utilizes a medium-scale general purpose digital computer as the nucleus of all information-processing activities. All branch orders are received by the West Coast message center and are automatically routed on to New York where they are simultaneously sent to the Exchange and to the data processing center. Execution reports from the Exchange are sent directly to the originating branch and to the data processing center. These orders and execution reports are received on 5-channel teletype tape which is fed directly into the computer. The volume of business handled during the five and one half hour trading day, coupled with overall speed requirements, necessitate a system capacity of twelve such order-execution pairs per minute.

Basic input is also provided to the system by the branch and New York office reports of daily receipts and disbursements of cash and securities. This extensive input data must be processed each day according to a rigid timetable. In general, all of one day's business activity must be completely recorded and processed before the start of the next trading day. All of this work is subject to the detailed scrutiny of various Exchanges, the S.E.C., and the auditors.

By utilizing the extensive private wire system, the data processing center in New York is able to direct the complex daily operational activities of this company. Furthermore, although the company's top management is separated from the data processing center by 3,000 miles, the center is able to provide them with a normal supply of reports while at the same time rapidly fulfilling requests for special analysis.

A Transportation Company

"Y" is a medium-size company in the transportation industry. The main volume of their work is concerned with cross-country movement of railroad freight cars. The majority of such movements originate in East Coast ports and are destined for Western cities. However, a considerable portion of volume consists of overnight movements into such midwestern cities as Chicago, St. Louis, and Cincinnati. A further complication is caused by the frequent necessity of transfer operations, as when Baltimore and Boston shipments are merged in St. Louis before going on to Los Angeles.

A Shipping Order is prepared by the customer and delivered to the Company with each consignment of merchandise. These Shipping Orders are the basic input to the system and are used to prepare Freight Bills, Railroad Manifests, Receivables Entries, and so forth. A completed Freight Bill must precede each shipment to its destination and must be on hand at the appropriate Transfer Points before arrival of the various freight cars. All daily processing activities are subject to I.C.C. regulation and are continually compared by Carrier Railroads with their own computations. Our client processes an average of 10,000 Shipping Orders each working day.

The data processing operations of this company are characterized by a large mass of input data, a requirement for flexible processing schedules that allow for the periodic interruptions of rush movements, and a high volume of printed output accompanied by a moderate amount of punched paper tape output suitable for direct teletype transmission.

Our system design for this company utilizes a medium-scale general purpose digital computer installed in a Data Processing Center located in Chicago. Due to the fluctuating nature of data transmission time schedules, the overall system design is based on combined use of direct teletype input and output and extensive air mail communication. Original Shipping Orders, as well as other operational data, are sent to the data processing center, which functions as the controlling element for the entire company. In addition to processing routine daily operating data, the computer is utilized for the formulation of strategic decisions as to selection of optimum freight car routings and Carrier-Tariff combinations.

Operational Characteristics

The X Brokerage House and the Y Transportation Company are in two vastly different fields of business. Yet the requirements and characteristics of the data processing systems that have been designed for these companies are strikingly similar. These similarities reveal a great deal about the nature of such business systems:

Both companies operate over a wide geographic area and use an extensive communications network and a medium-scale computer in a central data processing installation.

In both cases, basic input data is provided by activities that are outside of the system and are essentially uninterested in the workings of the system and the difficulties that are caused by incorrect data.

In both cases, input data arrives in a fairly random fashion but must nevertheless be processed upon receipt, since all operations are conducted against fairly intractable time deadlines.

In both cases, normal operational schedules must be flexible enough to accommodate the intermittent interruptions of rush jobs.

In both cases, internal system processing must conform to rulings of various outside regulatory agencies.

"Real Time" Business Systems

The most important characteristic of both systems, however, is that they are "real time" business systems. The standard definition of a real time data processing system is one "whose actions influence the input data that is being received". In the world of business data processing systems, this definition may be modified to read: "A real time business system operates on-line with its input data". One such automatic real time business system is the American Airlines Reservisor system wherein passenger requests for seats are satisfied as they are received with essentially no processing delay.

Until very recently, almost all commercial installations of general purpose computer systems were used in non-real time situations and relied extensively on "batch processing" techniques. Examples of areas that are amenable to such techniques form an honor roll of the problems first handled by business systems: Payroll, Receivables Accounting, Inventory Accounting, Insurance and Utility Billing, and so forth.

The functional nature of a real time business system requires that essential control and direction of the business be vested in the data processing system itself. Both of the systems described above receive information concerning the environment or stimuli of the business. In one case these are orders for security trades; in the other, they are Shipping Orders. The automatic system processes the information contained in these initial messages and issues directions so that successive appropriate measures may be taken. Finally, the data processing center is notified of the results of these actions and acts to issue either corrections or instructions for further measures. All operational data funnels into the processing system and all routine operational directions issue from the system. Further, the formulations of company management are based on analysis prepared by the data processing system from information that is contained in the records of the system.

An operation of this type sounds delightful to the systems engineer, for we have in large measure eliminated the human element from routine business functions. The automatic system directs and controls daily operations while using the results to provide management with timely reports on which to base long-range policy decisions.

However, the practical businessman views such a system in an entirely different light. The system will reduce direct operating costs; it will provide greater flexibility and efficiency than the present manual system; management will receive information in time to formulate important decisions that direct the company's future operations. But, while accepting the validity of such advantages, the executive also realizes that if this beautiful system should fail, his company will be out of business.

In the final analysis, this factor of reliability is the most important characteristic of real time business systems and provides the greatest single functional difference between on-line and batch processing systems. If the payroll is late, there will be unhappy labor force, and if the utility bills are delayed the company will be correspondingly tardy in receiving revenue. But if an on-line system fails, all company operations cease.

Reliability in Real Time Systems

At the same time, the inherent benefits that may accrue from the utilization of automatic real time business systems are significantly greater than those provided by the earlier systems. It is just this factor of automatic control of routine operations that provides the appeal of on-line systems. For the effect of a day's activity will be reflected in reports early enough for the executive to exert an effective influence on these same operations. Such real time data processing systems are capable of implementing the theory of "management by exception" in actual daily operations.

We thus have a system concept that can provide extensive and valuable benefits to a business organization and can also do irreparable harm in case of failure. Accordingly, we must provide a system design that will reliably ensure against failure while retaining the maximum benefits. Only in this fashion, can we hope to implement this significant step forward in the application of automatic data processing.

In the design of real time business systems we have adopted a concept that is based on the assumption that all components of a system are liable to failure, but that overall operations must not fail. One of the simplest and most effective means of ensuring system reliability is through the use of redundancy. This technique is utilized by the human brain and nervous system, and the analogy is a natural one since the data processing system functions in a similar fashion for the business organism. However, in view of the economic realities of commercial life, it would appear more practicable to approach the problem in a slightly different manner.

The first requisite of our system is high quality of design and performance in each individual element. Practically, this implies that only proven components can be incorporated in the system. As newer computers are developed, they should be "broken in" on the batch processing problems. If that is not feasible, one must insist on a substantial period of rigorous testing before accepting such equipment.

Continual preventive maintenance of all equipment is required. A number of engineering installations of medium-scale computers adopted the practice of eliminating preventive maintenance periods. These organizations

(cont'd on page 42)

AUTOMATIC SEARCH OF LIBRARY DOCUMENTS

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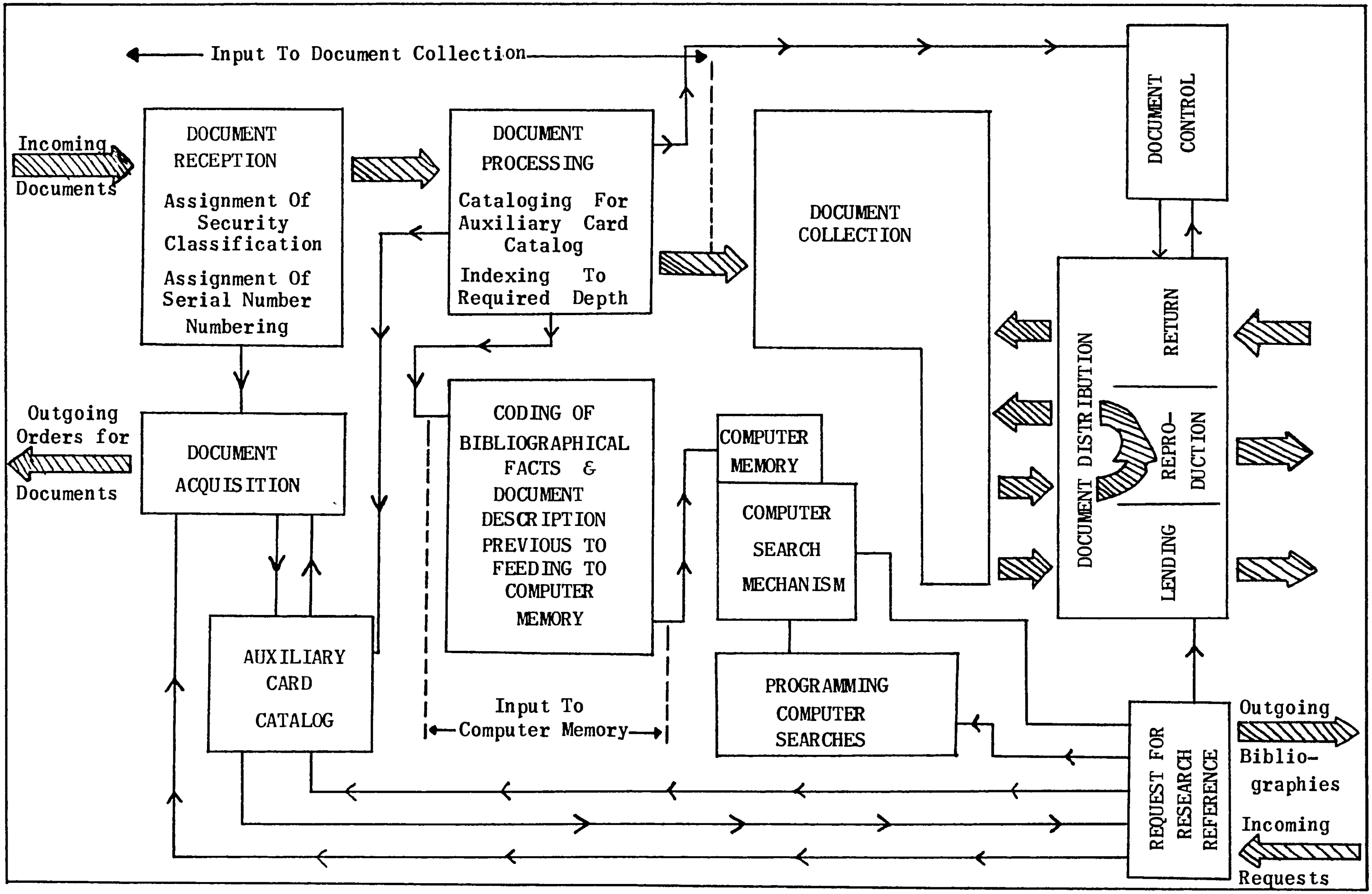
The idea of an automatic library has been the object of speculation for a considerable length of time. Various schemes, some grandiose and some quite modest, have been advanced for its accomplishment. Some involve machinery that would stagger the designers of a modern oil refinery, while others are quite simple; some display Rube Goldberg overtones, and others seem quite sensible. Most of them aim at a level of automation and a speed of operation that still require development and research before becoming realities. However, if these schemes are discarded and an examination is made of the various types of automatic machinery already in production in the plants of electronic computer manufacturers, it will be possible to automatize many of the operations of the modern library. Although the ultimate degree of automation has not yet been realized, sufficient progress has been made to eliminate many man-hours of labor. While the possible speed of operation is not phenomenal, when viewed in relation to the speed of present methods it does represent a very substantial saving of time. The cost, furthermore, will be considerably less than that for present methods of operation.

Currently, both industry and science are finding it increasingly difficult to retrieve, for research purposes, information stored in special and general purpose library collections. This situation is the result of the present overflow of information that not only contributes to the time and care required in finding anything specific in an already massive collection, but also complicates the task of adding the constantly expanding incoming flow of new information to that collection.

Naturally, a great capital investment is necessary to install electronic computers and automatic machinery in a library. This fact may be viewed by many with trepidation, but several industries and government agencies already have electronic computers that could be devoted to part-time library work, thus greatly reducing the initial investment. Such agencies normally represent a specialized field of endeavor and have libraries that might contain 100,000 to 200,000 documents, i.e., publications or parts of publications considered as single units for indexing purposes. If an automatic installation were made, various possibilities of improved operation would open up, and substantial savings of time and money, as well as increased thoroughness, would accrue to industrial research. Electronic computer manufacturers, consequently, would soon begin to design and build special purpose machines for increasing the speed of operation to a point where the goals of the visionaries would be approached.

At the present time, the speed of existing production models of automatic data-handling machinery probably makes the operation impractical for libraries of more than 1,000,000 to 2,000,000 documents, unless the required machinery is installed in multiple units. Furthermore, the initial cost of such an installation would be prohibitive. Although obsolescence might be a serious factor initially, stimulated interest would soon produce special equipment capable of greater speed, and such institutions as the Library of Congress, as well as the predicted 50,000,000 document library of the future, could be automatized.

The idea of using electronic computers for searching the document collection of a library is not new. In 1951 Philip Rutherford Bagley prepared at the Massachusetts Institute of Technology a master's thesis entitled <u>Electronic Digital Machines for High Speed Information Searching</u>.[1] Because of the rapid growth of the mass of published articles, books, etc., during the past few years, he specified that the machines must be able to search 50,000,000 documents within a reasonable length of time. Bagley's method of recording the necessary information in the memory system of the electronic computer involves the use of a series of terms called <u>descriptors</u> which consist of single words used singly or in groups to describe the characteristics of the subject matter of a document. This information is arranged in the memory system of the computer in the form of consecutive lists of descriptors, each list describing a single document headed by its serial number. This document record consists of only two types of information: (1) the serial number of a document which allows for its positive identification; and (2) a number of descriptors that describe



A schematic diagram of the flow of information among the various operations and parts of a modern library that utilizes an electronic computer for literature searches (information retrieval).

the contents of the text of the document. Bagley's method provides for an average of 30.0 descriptors per document, as well as for a search procedure designed so that various numbers of descriptors in various combinations can be specified as the subjects of the information retrieval operation. Investigation revealed that the digital computer, Whirlwind I, could search approximately 11,990 documents per hour and would require approximately 41,700 hours to search a collection of 50,000,000 documents. Bagley then outlined an idea for a special purpose computer that could be designed to search documents at the rate of 4.66 million per hour (or 10.7 hours to search a document collection of 50,000,000).

Recently, Harley E. Tillitt, at the U.S. Naval Ordnance Test Station at China Lake, California, published a paper entitled An Experiment In Information Searching With The 701 Calculator. Like Bagley, Tillitt used in his experiment the mechanism of the descriptor to delineate the contents of the document, but he recorded each descriptor only once and associated serial numbers with it. Thus the record in the memory system contains lists of serial numbers of many different documents headed by a single descriptor, signifying that each document in the list contains the information labeled by a descriptor at the head of the list. In this system, each consecutive list refers to many documents. As in Bagley's method, the record consists of only two types of information: (1) a serial number that allows for positive identification of the document; and (2) a number of descriptors that define the contents of the text of the document. Tillitt's operation actually adapted the Uniterm system to an IBM 701 Electronic Data Processing Machine and used an average of 7.6 descriptors per document. This method provides for searches by the IBM 701 of various numbers of descriptors in different combinations.

Using this system, Tillitt found that he could record the information for approximately 34,000 documents on a 1200 ft. magnetic tape. Because of divergent factors peculiar to different types of searches, he found that the minimum search time for 34,000 documents was 20 seconds and the maximum 4 minutes. If the maximum search time is used as a base, Tillitt's method would provide a search rate of 510,000 documents per hour, or 98.04 hours for 50,000,000 documents.

Both Bagley's thesis and Tillitt's operation were aimed at overcoming the problem of retrieving information stored in a document collection. The solution of this problem would remove one of the major obstacles in carrying out adequate literature research today. However, the problems of the modern library do not consist solely of information retrieval. Another major obstacle is the processing of incoming documents before they are put into the document collection and thence become available to individuals engaged in research. The processing of documents consists of assigning serial numbers, numbering the document, cataloging the document, and preparing appropriate records for document control. With the increasing mass of publications in recent years, processing of documents has created a serious delay in the progress of information storage in itself, so that it is not uncommon for large libraries of one to two million items to have documents backlogged for as much as one or two years. Such a situation impedes research, inasmuch as current publications are not available in collections. Naturally, this is an important factor, considering the current advances in scientific research. In view of this fact, it would seem that there is a need, not only to provide faster means of searching document collections, but also to streamline and mechanize the processing of documents for a collection. These things must be done before the problems of the modern library will be solved even partially.

A study of the modern library reveals that the use of electronic computers for search activities will not permit us to eliminate the card catalog completely. Search activities which involve checking for the presence or absence of a particular document, locating a document by a given author, finding any document under certain broad classifications, etc., can still be carried out best by the use of a card catalog. However, the card catalog thus actually becomes an auxiliary aid and should be considerably streamlined so that it would contain only author and title cards and a maximum of three of the traditional subject cards per document.

A new operation, indexing by the use of descriptors, takes the place of extensive cataloging. The product of this process is the record which is searched by the computer mechanism. The use of descriptors for indexing eliminates the necessity for making numerous involved judgments which are critical to the efficient functioning of the standard card catalog as an information retrieval system. This being true, personnel requirements for the indexing operation may be somewhat lowered in respect to the extent of time required for training, and the level of intellectual ability of the trainee. This would tend to ease the existing shortage of professional librarians and would also release such people for the more critical tasks of documentation in the automatic library.

Other items necessary to the functioning of a modern library are the accession record (a record of each document in the collection in the order of its receipt), the shelf list (a record of the shelf position of each document in the collection), and a series record (a record which allows for the location or grouping of any given series of documents issued periodically). These three records taken together constitute the document control system and they must be produced when the document is processed.

The author and Mrs. Gwendolyn M. Bedford, members of the Institute for Cooperative Research of the University of Pennsylvania, working in conjunction with Dr. Donald Thomsen and Mr. David Lawrence of the Applied Science Division of the Philadelphia offices of the International Business Machines Corporation, have designed a system that utilizes an IBM 705 Electronic Data Processing Machine to search document collections. The selection of IBM equipment for study as to the possibilities of such an application evolved from a survey of the Sharp & Dohme punch card information retrieval system at West Point, Pa. This system employs an IBM 101 Electronic Statistical Machine.

There is no doubt that the system devised at the Institution for Cooperative Research is compatible with other automatic machinery, since other computer builders have in production machines of similar scope and capacity. The intent in this system is to use a special assembly of IBM typewriter card punch equipment (or comparable equipment from any other manufacturer), including a number of remotely controlled typewriters, to produce in one operation all the cards for the auxiliary card file and all the necessary control records. This assembly of equipment will produce simultaneously all the necessary input to the computer memory.

The documentary information fed into the computer memory is called the document record in this system. It consists of two sections, a bibliographical facts section and descriptor section. The bibliographical facts section contains seventeen facts about the document, such as an identifying and locating number, the author or authors, the publisher, the date of publication, etc. The descriptor section of the document record contains an average of thirty descriptors per document to define the contents of the document. ' On the basis of past experience, it was decided at the time this system was designed that an average of thirty descriptors per document is necessary to define the contents completely enough to locate the various types of information a document may contain. Within the descriptor section it will be possible, if it is so desired, to signify such things as the year or era, the geographic and political areas to which the contents pertain, and the basic nature of the contents.

In this system, as in Bagley's, each consecutive list of information in the memory system of the computer refers to a single document. The list contains (1) the serial number of the document, allowing for its positive identification, (2) the shelf location, (3) the bibliographical facts such as author, publisher, date, etc., and (4) the list of descriptors pertaining to that document.

The coding system designed for the descriptor section obviates some of the difficulties existing in earlier systems such as Uniterm and various other adaptations of Coordinate Indexing. The system under discussion provides for the division of the descriptors of any given document into arbitrary groups. Thus two or more discussions in a single document may be specified as related or unrelated. If this feature is used in conjunction with certain types of search programs, the breadth as well as the level of abstraction of the retrieved information may be controlled. At the option of the user, this system also provides for the qualification of descriptors that appear in the descriptor section of the document.

The system under discussion carries much more information in the computer memory (the document record) than the systems of either Bagley or Tillitt. The inclusion of seventeen bibliographical facts permits one to locate any document that contains the necessary information, whether the search be carried out by author, by issuing agency, or by publication date. The reader can easily imagine many other combinations that might be desired. The experience of research libraries, moreover, corroborates the necessity for such flexibility and capacity.

Such a document record, with seventeen bibliographical facts and thirty terms in the descriptor section, will be stored on reels of magnetic tape. Each 2500 ft. reel of tape will hold the record of 14,000 documents. This document record can be searched by an IBM 705 Electronic Data Processing Machine at the rate of 150,000 documents per hour. The results of the search will be delivered by the printer of the Electronic Data Processing Machine in the form of a list (bibliography) of identifying and locating numbers for the documents containing the desired information. Upon request, the printer could print out the entire document record of each document. To study the bibliography more intensively before consulting the documents themselves, one would need only to decode the document record. One IBM 705 Electronic Data Processing Machine would require 333.33 hours to search a library of 50,000,000 documents (Bagley's goal), using the system described here. Since such a length of time is prohibitive, it would seem that search of a 50,000,000 document library will have to await the development of some such device as Bagley's "special purpose computer".

The system described here is slower than Tillitt's operation with the 701 but, were Tillitt to raise his average descriptor load from 7.6 to 30.0 descriptors per document, it appears that his search speed would be cut from 510,000 to 146,166 documents per hour. If he were also to include 17 bibliographical facts, the speed seems to drop to 93,279 documents per hour. This is only a tentative estimate because there may be several ways of arranging the record in the memory system of the computer. Some of these arrangements might increase the speed of search to more than 93,279 documents per hour. On the other hand, there is a chance that it may be impossible to include more than one bibliographical fact in Tillitt's system (in this case an identifying number or serial number of the document) because of the way he lists his records of documents in the computer memory.

During the winter of 1953-54, the writer was concerned with a literature search of a library of approximately 1,000,000 documents for some important key facts connected with a problem. After 600 hours of labor had been expended at the cost of approximately $1425, nearly 1700 promising document titles had been assembled from the card catalog, and from various abstracts, footnotes, indices, bibliographies, etc. The 1700 documents themselves had not been examined. For various reasons, including cost and lack of personnel, the search was abandoned at this point. However, as a conservative estimate, the time required to make an adequate examination of the 1700 documents would certainly be in excess of 850 hours. The labor charges for this operation would have amounted to at least $2025. At this point, the costs are already $3450, without the inclusion of any charges for stenographic services or materials. Even with such an expenditure, the search would have exploited neither the major portion of the collection's periodical holdings nor a number of other possible source areas.

More important than the fact that some areas were not searched is the fact that, because of conventional methods of cataloging, many relevant references were undoubtedly missed in the areas that had been covered. It should also be noted that, in the areas that were thoroughly combed, many irrelevant references were undoubtedly tagged for examination. Although these two situations may occur in searches conducted by electronic computer, they are not likely to do so because the descriptor concept of indexing is more flexible and at the same time more precise than the conventional method.

What about cost and time outlays for information retrieval procedures of the system outlined in this article? An IBM 705 Electronic Data Processing Machine costs approximately $28,180 per month. A crew of six operating 21 hours a day, or two people on each shift, would cost approximately $3000 per month. Each shift would consist of an operating specialist ($8000 per year) and a service clerk ($4000 per year). It is difficult to estimate what other personnel and material are necessary or at what point cataloging and library control services leave off and literature searching activities begin, but it would seem that an additional $10,000 per month would take care of this overlap, as well as of additional staff and material needs. This staff would program searches during the day for the around-the-clock operation and enter records of documents in the memory system. Thus the total operating costs add up to approximately $41,180 per month, or $2059 per day. Under the system outlined, the machinery could search, barring breakdown and excluding multiple searches, 3.15 million documents every 24 hours (21 hours of work). If the machine were operated 20 days per month, the cost would be approximately $653.65 per search of 1,000,000 documents, or 18.9% of the $3450 necessary to carry out the same operation by a completely human agency. The result of the search would be delivered in the form of serial numbers of documents (and in many cases page numbers of the desired information) which would permit the location of any document in the document collection.

So far as time outlays are concerned, such a system would allow the search of a million documents every 6.66 hours without an increase in capital investment for machinery, barring breakdowns and multiple searches. If demands were so heavy as to make it necessary to install two electronic computers, search time per million documents could be cut to 3.33 hours at approximately the same cost. If all previous data set forth in this discussion are accepted, it can be readily estimated that an equivalent but less precise and complete search of a million documents could be carried out by a completely human agency in 6.66 hours, with approximately 221 individuals using existing library facilities and equipment. However, the point must be made that the coordination of a force of 221 individuals to prosecute such a search represents an almost insurmountable problem. In addition, it must be pointed out that the task of procurement of so large a group capable of pursuing such a search is virtually impossible. It is certain, in any case, that the cost would still exceed $3450.

Table 1 (see below) summarizes the speeds of the various methods of literature searching that have been discussed in this article.

It must be re-emphasized that the cost estimates given here for a human agency's searching operations are extremely conservative. In addition, attention should be called to the fact that 6897 documents are not actually examined per hour in such an operation. The major portion of the 6897 are really documents whose titles, contents, and catalog cards are not examined or even known by the searcher. Whereas the electronic computer actually searches every document record, the human agency searches only in certain areas of the card catalog where subject headings, etc., indicate that the documents containing the required information are likely to be listed. Thus, vast areas of the catalog are eliminated without ever being touched. The figure of 6897 documents per hour may also vary widely from searcher to searcher and from search to search because of differences in card catalog construction as well as in the efficiency and thoroughness of the searcher. In most cases it is highly probable that the documents searched by a completely human agency will number far fewer than 6897 per hour.

On the other hand, it can be stated that the probabilities that the actual operating speed will approximate the estimates for Whirlwind I, the IBM 705 system, and Bagley's "Special purpose computer" are high if the planned procedures are used. Of course, there is no question about the speed of operation of the IBM 701 system using Tillitt's system, since his data are drawn from actual experience.

In conclusion, the savings accrued through the use of automatic machinery versus the completely human agency, insofar as they are predictable at this time, can be summarized as follows. The IBM 705 system, staffed by the necessary crew, could do a literature search of a document collection in approximately two percent of the man-hours required by a completely human agency; the cost of such a search would be approximately 18.9% of the cost of carrying out the same search by a completely human agency; and the results of the search would be more accurate, thorough, and complete than the results of a search carried out by a human agency. In respect to input to the document collection *per se*, it would seem that this can be simplified and expedited considerably by the use of descriptor indexing in conjunction with existing items of automatic machinery. Finally, the electronic computer as an information storage mechanism offers unlimited possibilities for a higher potential number of descriptors and bibliographical facts per document than any existing automatic equipment.

TABLE 1

Comparative Speeds of Various Search Agencies

Searching Agency	Documents Searched Per Hour	Time Required to Search: 100,000 Documents	1,000,000 Documents	50,000,000 Documents
Completely Human Agency	6,897	145 man hours	1450 man hours	72,500 man hours
Whirlwind I	11990.4	83.4 hours	834 hours	41,700 hours
IBM 705 system as described in this article	150,000	.66 hours	6.66 hours	333.33 hours
IBM 701 system using Tillitt's method	510,000	.196 hours	1.96 hours	98.04 hours
Bagley's Special Purpose Computer	4,761,900	.021 hours	.214 hours	10.72 hours

IRE NATIONAL CONVENTION, MARCH, 1957, NEW YORK —

TITLES AND ABSTRACTS OF PAPERS BEARING ON COMPUTERS AND DATA PROCESSORS

The Program of Technical Sessions of the IRE National Convention in New York, March 1957, contains a number of papers having some relation to computers and data processors. Following are the titles and abstracts of these papers, and notations of the part of the IRE Convention Record in which they will be published. Copies of this publication will be obtainable from The Institute of Radio Engineers, Inc., One East 79 St., New York 21, N.Y.

SESSION 6

Sponsored by the Professional Group on Communications Systems. To be published in Part 8 of the 1957 IRE Convention Record.

MULTIPLEX COMMUNICATIONS SYSTEMS

6.2 Time-Division Multiplex System with Addressed Information Packages - R. Filipowsky and E. Scherer, Westinghouse Electric Corp., Baltimore, Md.

A digital multiplex communication system is described wherein the channels are combined in asynchronous time division; there is no fixed and predetermined sequence by which the individual transmission interval is electronically "auctioned" and is allotted to the highest bidder, i.e., to the channel having instantaneously the most urgent need for forwarding its message or a fraction thereof. The receiver has no knowledge to which channel the information within one transmission interval should be directed, unless each interval will carry its own address. One interval may contain one quantized sample only or a larger amount of time compressed information, i.e., one information package.

SESSION 9

Sponsored by the Professional Group on Automatic Control. To be published in Part 4 of the 1957 IRE Convention Record.

AUTOMATIC CONTROL--GENERAL

9.1 Digital Controllers for Feedback Systems - J. R. Ragazzini, Columbia University, New York, N.Y.

A digital controller for a feedback control system is a computer which accepts a sequence of numbers at its input and delivers a processed sequence of numbers at its output. The implementation of the computer may be completely analog or digital, or a combination thereof, as will be shown by typical designs. The output sequence of the controller may be generated at a rate equal to or at a multiple of the input sequence rate. For linear systems, it is possible to program the computer to cause the control system to have a desirable over-all prototype response subject to certain theoretical limitations. For computers in which the output data rate is a multiple of the input rate, faster response can be achieved. The theory of sampled-data systems is applied to the synthesis of the digital controller program which will produce these desirable prototype response functions. The theoretical restrictions which limit the choice of response functions are pointed out. Examples of typical designs which illustrate the theory are given.

9.4 Solution of Statistical Problems by Automatic Control Techniques - R. L. Cosgriff, Dept. of Elec. Eng., Ohio State University, Columbus, Ohio

It has been widely accepted that many processes in the broad field of science essentially can be classified as closed-loop systems. Many of the problems encountered in these fields are essentially statistical in nature and, as a result, have not been analyzed using the differential equation approach; however, autocorrelation and spectral density approach have been used. It is demonstrated that the differential equation approach can be used to determine the expected behavior of many of the "statistical type systems."

SESSION 22

Sponsored by the Professional Group on Information Theory. To be published in Part 2 of the 1957 IRE Convention Record.

INFORMATION THEORY--APPLICATIONS

22.1 An Inductive Inference Machine - R. J. Solomonoff, Technical Research Group, New York, N.Y.

A study has been made of a category of machines that will perform inductive inferences. A simplified model will be described that only uses a few of a more complete set of heuristic devices. Such a machine is able to learn arithmetic operations from a small set of examples.

By using all of the heuristic devices, it is expected that a machine will be able to learn to perform complex tasks for which it was not specifically designed. Proving theorems, playing good chess, and answering questions in English appear to be within ultimate machine capabilities.

22.2 Multicase Binary Codes for Nonuniform Character Distributions - F. P. Brooks, Jr., International Business Machines Corp., Poughkeepsie, N.Y.

For economical transmission, variable-length coding systems are theoretically best for nonuniform character distributions, but difficulties of decoding and checking limit their practical usefulness. A useful class of variable length codes are the multicase codes, in which the characters (messages) to be represented are divided into two or more cases, with shift characters signaling changes in the case of succeeding characters. Analysis of the properties of multicase coding systems yields a method of generating and selecting economical variable-length codes that can be readily encoded, decoded, and checked.

SESSION 23

Sponsored by the Professional Groups on Electron Devices and Broadcast and Television Receivers. To be published in Part 3 of the 1957 IRE Convention Record.

TELEVISUAL SYSTEMS DEVICES

23.4 An Electrostatic Character-Writing Tube - K. Schlesinger, B. Maggos, and A. F. Hogg, Motorola, Inc., Chicago, Ill.

A 19-inch charactron tube has been developed, which uses electrostatic fields throughout for character selection and distribution, as well as for image formation and intensification. Two pairs of conjugate electrostatic yokes are used for letter-selection, and a fifth unit for character-positioning at wide angles (70 degrees).

A long decelerating electrostatic lens is used for image formation, permitting instantaneous change of size between small and capital letters.

A new barrier-mask accelerator has been developed to increase beam velocity twelve-to-one over the last inch of its path ahead of the screen.

SESSION 26

Sponsored by the Professional Group on Electronic Computers. To be published in Part 4 of 1957 IRE Convention Record.

ELECTRONIC COMPUTERS I--DIGITAL COMPUTERS

26.1 An RCA High-Performance Tape Transport System - S. Baybick and R. E. Montijo, Radio Corp. of America, Camden, N.J.

A high-performance, multichannel digital tape transport has been developed to meet the needs of the data processing industry in general. This is tubeless equipment which provides very fast start and stop times at very high repetition rates through the use of semi-conductor and magnetic components.

This paper describes the electronics and mechanism in detail including the methods employed in obtaining start-stop rates to 120 per second, start and stop times of less than 2 milliseconds, and a start-stop spacing of less than 0.2 inches. The transport handles various widths of tape from 1/2 to 1 1/8 inches and magnetic heads which provide up to 18 recording tracks.

The weight-type reel servo system, the high-current transistor solenoid driver, and the tape control logic are also described. Several unique features of this equipment have been employed in this developmental equipment to achieve performance and enhance its reproducibility.

26.2 A Magnetic Pulse-Current Regulator - J. D. Lawrence, Jr. and T. H. Bonn, Remington Rand Univac, Philadelphia, Pa.

This paper describes a magnetic current regulator using a square hysteresis loop core with two windings. A direct current flowing in one winding holds the core in a saturated condition and provides a current reference for regulation. The core presents a low impedance to a current pulse passing through the other winding until the pulse mmf exceeds the dc mmf. When this happens, the core moves into the unsaturated region of its hysteresis loop and presents a high impedance to the current pulse, thereby preventing further increase in this current pulse.

Design considerations are presented. The precision of regulation is directly proportional to the number of turns on the pulse winding and inversely proportional to the magnetizing mmf required by the core in its unsaturated region. Hence, precision of regulation is limited by the amount of air core inductance that can be tolerated and the number of turns that it is physically possible to place on a core. The use of a thin-wall metal bobbin substantially improves the regulation.

26.3 Diodeless Magnetic Core Logical Circuits - L. A. Russell, IBM Research Center, Poughkeepsie, N.Y.

Magnetic cores having rectangular hysteresis loops have been shown to be useful as a key element in logical circuits for digital computers. However, most of these circuits use diodes for coupling, requiring windings of large numbers of turns, or large cores. A special class of magnetic core logical circuits will be presented in which cores are used for coupling. By avoiding the use of diodes, these circuits offer major advantages in economy, reliability, and compactness in medium speed applications. The basic technique that eliminates the need for diodes requires that some of the cores have a switching threshold. Specific examples of possible circuits and their operating characteristics will be shown.

26.4 Digital Computer Designs Circuit for Longest Mean Time to Failure - J. Alman, P. L. Phipps and D. L. Wilson, Remington Rand Univac, Div. of Sperry Rand Corp., St. Paul, Minn.

This paper describes a system of circuit design utilizing a digital computer. The digital computer is programmed in such a manner so that it can compute the circuit that would give the longest mean time for failure of the circuit. This is accomplished by programming into the computer the characteristics of life test of components. The computer computes the circuit many times looking for the combination of circuit components that would still meet the output requirements and give the longest mean life to failure. The main computer output then becomes just the circuit which would give the longest mean time to failure possible with the existing component characteristics which were programmed into the computer.

26.5 Considerations in the Design of Character Recognition Systems - E. C. Greanias and Y. M. Hill, International Business Machines Corp., Endicott, N.Y.

The basic factors pertaining to the Character Sensing problem are discussed. These are range of style, range of quality, and number of characters and symbols to be recognized. Possible definitions of character quality and units for measuring it are described. The information handling steps of the recognition process are outlined as:

1) Conversion of marks on paper to electrical signals.
2) Discrimination between signal and noise.
3) Reduction of filtered data.
4) Identification of characters and symbols based on reduced data.
5) Validity checks.

The use of digital computers in the simulation of data reduction and recognition is described. A method for generating realistic test specimens on a digital computer is outlined.

SESSION 28

Sponsored by the Professional Group on Nuclear Science. To be published in Part 9 of the 1957 IRE Convention Record.

NUCLEAR INSTRUMENTATION

28.3 0.1-Microsecond, 2000-Channel, Electrostatic Storage System for Time-of-Flight Experiments - J. Hahn, Dept. of Physics, Columbia University, New York, N.Y.

An instrument has been developed for measuring neutron time-of-flight which has 2000 discrete time channels, each having a width of 0.1 microsecond. A temporary electrostatic storage is used in conjunction with a magnetic drum memory. Neutrons initiated by a cyclotron burst, which occurs at approximately a 60-cps rate, are detected after traversing a fixed flight path, and their times of arrival are stored in the electrostatic memory. Before the next burst occurs the stored information is read into the drum, and the storage tube is cleared. This paper describes the electrostatic storage system and circuitry. The major system blocks which are discussed are: the 10-mc pulsed oscillator and clock pulse generator; the "clock-stopper" or staticizer; the fast carry flip-flop deflection circuit drivers; the current adder stairstep deflection generators, and the storage tube.

SESSION 35

Sponsored by the Professional Group on Audio. To be published in Part 7 of the 1957 IRE Convention Record.

SPEECH ANALYSIS AND AUDIO AMPLIFIERS

35.1 A Demonstration of the Representation of Speech by Poles and Zeros - S. H. Chang and R. Bach, Jr., Northeastern University, Boston, Mass.

Aside from the phonemic description of speech the most effective representation of speech is supplied by the dynamic model. The latter concept of excitation functions and system functions is very appealing to communication scientists. Work remains to be done to demonstrate how successful this concept is in solving speech compression problems. This paper demonstrates our progress to date.

SESSION 40

Sponsored by the Professional Group on Production Techniques. To be published in Part 6 of the 1957 IRE Convention Record.

PRODUCTION TECHNIQUES

40.2 An Approach to Airborne Digital Computer Equipment Construction - P. E. Boron and E. N. King, Hughes Aircraft Co., Culver City, Calif.

This paper is a discussion of one method of building airborne digital equipment, making use of the unitized etched wiring plug-in philosophy and utilizing an all-etched wiring harness to make the large number of connections between plug-in units. Points of emphasis are miniaturization, reliability, small weight, accessibility, and manufacturability of the equipment.

SESSION 41

Sponsored by the Professional Group on Electronic Computers. To be published in Part 4 of the 1957 IRE Convention Record.

ELECTRONIC COMPUTERS II--SYMPOSIUM ON COMPUTERS IN SIMULATION, DATA REDUCTION, AND CONTROL

Chairman: R. D. Elbourn, National Bureau of Standards, Washington, D.C.

A rapidly expanding class of computer applications that includes the simulation of complex systems in real time, on-line reduction of experimental data, and automatic process control is introducing new problems that were not met in the mathematical and business applications.

Problems of speed and control affect the design of the computer itself. For sufficient speed it may have to be wholly or partly analog or, if digital, it may have to be a special purpose rather than general purpose machine. The control may have to permit interruption for special tasks and then return automatically to a former task.

Communication between the computer and the rest of the system may involve problems of conversion between analog and digital data, of multiplexing many data channels into one computer channel, of smoothing or interpolating sampled data, or of preparing displays suitable for human beings.

The first two speakers will deal generally with these problems, then three speakers will describe their solutions in three specific applications:

1) A large combined analog-digital simulator.
2) The digital control of machine tools.
3) The reduction of wind-tunnel data.

After these talks there will be a round table discussion of present and future solutions of these problems.

SESSION 44

Sponsored by the Professional Group on Industrial Electronics. To be published in Part 6 of the 1957 IRE Convention Record.

INDUSTRIAL ELECTRONICS

44.1 The Canadian Mail Handling System and the Problem of Coding - M. M. Levy and A. Barszczewski, Post Office Dept., Ottawa, Ontario, Canada

The Canadian Post Office has under development an Electronic Automatic Mail Sorting System. The efficient operation of the system is made possible by use of a proper code and coding methods.

The proper names of towns, villages, and streets are converted into a special code suitable for electronic handling.

The process of coding is performed mentally by the operators according to a set of simple rules. The addresses of letters are read by the operators in special reading stations and mentally coded, the code is then marked on the envelopes by a special keyboard. Afterwards the remaining operations are performed completely automatically.

The prototype of the system is briefly described. The paper is dealing mainly with the coding problem and human factors involved in it. A clear account is given of various codes and coding aspects. Description is given of minimization of errors. The realization of a working system did depend to a large extent on suitable coding and therefore its importance is stressed.

Although this paper is restricted to the specific application only, nevertheless the methods used have large potential possibilities in other fields where realization of electronic sorting and filing of data is essential.

SESSION 45

Sponsored by the Professional Group on Reliability and Quality Control. To be published in Part 10 of the 1957 IRE Convention Record.

RELIABILITY PROGRAMS

45.1 Air Force Ground Electronic Equipment Reliability Improvement Program - J. J. Naresky, Rome Air Development Center, Griffiss Air Force Base, N.Y.

As the demands of modern warfare have dictated increases in electronic equipment complexity, reliability has been correspondingly decreased, thus necessitating the institution of a comprehensive program of reliability improvement in the Department of Defense. This paper describes the factors leading to the development of the program at the Rome Air Development Center and the methods of its implementation on radar and other ground electronic equipment developed by RADC.

The RADC Reliability Program--past, present, and future--is discussed. The general areas covered are: 1) Methods of educating design engineers on reliability; 2) development, verification and use of a reliability prediction technique; 3) development of automatic monitoring equipment; 4) component and circuit reliability improvement techniques, and 5) insertion of quantitative reliability requirements into equipment specifications.

45.2 A Reliability Program - R. E. Kuehn, International Business Machines Corp., Owego, N.Y.

The introduction of complex electronic systems into general usage has made the organization of reliability engineering groups a necessity. This group can function best by reporting to the manager of engineering as an independent evaluation and service agency. The tasks of reliability engineering include the development and application of reliability prediction techniques; the operation of a failure reporting and analysis system; the selection, qualification, and application of components; the environmental and life testing of components, units, and systems, and the evaluation of systems on the bench and in the field for reliability, maintainability, accuracy, and operational suitability.

45.3 A Reliability Program for R and D Projects - E. F. Dertinger, American Bosch Arma Corp., Garden City, N.Y.

The proposed paper will describe a long-range reliability program which has been inaugurated during the initial design stage of developing and producing an inertial guidance system for ballistic missile application. This program represents, to the writer's knowledge, the first all-out attempt to "design-in" complete missile system reliability.

Considerable effort will be extended toward presenting the procedures and techniques developed for "comparative evaluation" of functionally-suitable component parts and "reliability qualification" of: 1) parts selected for design incorporation, 2) assemblies and major components, and 3) complete systems. The philosophy of Arma management as regards reliability and the support given to this program will be described.

45.4 The Role of Quality Engineering in Procuring and Producing Reliable Products - R. A. Hulnick, International Business Machines Corp., Kingston, N.Y.

To assure production of a reliable product, quality engineering must formulate for the manufacturer a plan which encompasses a design of acceptable reliability, adequate controls over procurement and processing, and techniques for continuous performance evaluation for the purpose of product improvement.

SESSION 46

Sponsored by the Professional Group on Telemetry and Remote Control. To be published in Part 5 of the 1957 IRE Convention Record.

SYMPOSIUM--DIGITAL TECHNIQUES FOR PROBLEMS IN TELEMETERING AND REMOTE CONTROL

Chairman: C. H. Hoeppner, Jr., Radiation, Inc., Melbourne, Fla.

46.1 A High-Speed Digital Data-Handling System - G. F. Anderson, Radiation, Inc., Melbourne, Fla.

This paper describes a high-speed digital data-handling system which provides digitizing, editing, and processing of pwm and fm/fm data. This system digitizes a maximum of 22 channels of analog data at a channel-sampling rate of 22,000 data points per second. An over-all accuracy of one part in 1024 is provided, utilizing a 10-bit binary straight code. Simultaneous sampling of the data to an accuracy of 33 microseconds is provided. Editing is provided by the Quick-Look analog recording system. The processing system generates an output code compatible with the IBM 650 computer; however, with slight alterations, the output format can be made compatible with other types of digital computers.

46.2 Magnetic Tape Playback and Digital Conversion of Telemetered Flight Data for Entry into Digital Computers - G. C. Dannals, Radiation, Inc., Melbourne, Fla.

Paper describes an automatic digital conversion and data processing system designed and built by Radiation, Inc. for the AC Spark Plug Division of General Motors Corp. Decommutated and separated pdm and fm/fm data recovered during magnetic tape playback of telemetry records is electronically sampled and converted to ten-bit binary code and further processed to suitable form for entry into high-speed digital computers. Data editing, intermediate recording, and processing control features are incorporated. Other salient features as regards system accuracy, high-speed handling, and operational flexibility are discussed.

46.3 Design Considerations for Super Speed Perforated Tape Digital Recording - J. Bellinger, J. T. MacNeill, and C. F. West, Soroban Engineering Co., Melbourne, Fla.

Until recently, techniques for recording digital data on perforated tape have been perfected to meet the requirements of the communication industry. The recorder described in this paper probably represents the first tape perforator designed for instrumentation as well as digital computer output data recording applications.

The design now permits recording of standard 5, 6, 7, or 8-hole code patterns to be reliably performed at controlled rates up to 240 codes per second. The perforator executes a basic recording cycle of one code in approximately 4 milliseconds. Since a recording cycle can only be executed on demand associated electronic control circuits will permit recording of random or asynchronous data at variable rates up to 240/second.

46.4 A High-Speed Binary-to-Binary-Decimal Translator - C. A. Campbell, Radiation, Inc., Melbourne, Fla.

A high-speed translator has been developed which accomplishes binary-to-binary-decimal translation yet requires only about three vacuum tubes per bit.

By suitably arranging the feedback and trigger logic circuits the binary decades accept counts with weights of 1, 2, 4, 6, or 8. With minor circuit changes the counter will operate with any integral weight from 1 through 9.

Arranging these decades in cascade, inputs with weights of 16, 32, 64, etc., are accepted and totaled to decimal readouts, which may be in either binary or decimal presentation.

The present decade requires about five microseconds per binary digit for computation; however, the state of the art can allow an increase of at least tenfold in this speed.

46.5 Simplicity for Reliable Low-Cost Operation in a Digital Data-Processing System - J. W. Prast, Bell Aircraft Corp., Buffalo, N.Y.

A simple and straightforward digital data-processing system for telemetering purposes was developed in 1954 and has been in operation since that time for processing special precision information during test flights of guided missiles.

Experience gained in operational use will be reported with emphasis on reliability and cost aspects.

The system features 0.1 per cent accuracy, inherent reliability, and low cost on the advantageous side with limitations in versatility as a disadvantageous feature; it was originally designed for processing fm-type information essentially not changing over a sampling interval of approximately 50 milliseconds. Improvements and additional applications for processing information in analog-voltage form and fully automatic operation will be discussed.

SESSION 49

Sponsored by the Professional Group on Electronic Computers. To be published in Part 4 of the 1957 IRE Convention Record.

ELECTRONIC COMPUTERS III--MAINLY ANALOG

49.1 Computation with Pulse Analogs - N. Rubenfeld, W. L. Maxson Corp., New York, N.Y.

A special purpose semidigital computer has been built to handle a computation involving two analog frequencies and an analog voltage using novel techniques. The equation to be solved is

$$fx = \frac{E}{f_a} X f_b$$

The computation is done in two basic steps; the first step is computing a repetition rate $f_r = E/f_a$ and the second step is multiplying two frequency analogs, $f_r X f_b$. The entire computer is built using basic blocks, such as, flip-flops, gates, blocking-oscillators, and is completely transistorized. Because of the flexibility of the basic concepts, the dynamic range of the computer is virtually unlimited.

49.2 A Cyclic Digital-to-Analog Decoder - G. H. Myers, Rome Air Development Center, Griffiss Air Force Base, N.Y.

This paper describes a counting decoder which converts a binary number into a duration-modulated pulse many times in a computing cycle without sacrificing the economy of an ordinary, basic decoder. The device, which is part of the TRADIC computer, uses only transistors and achieves its features by using the "cyclic" nature of binary numbers. That is, if a binary number is placed in a register and a fixed amount is continually subtracted from it, the original number will reappear after a constant time interval. Decoding the same number many times has the effect of giving the decoder a considerably greater bandwidth, which is an important consideration in control or servomechanism problems. The decoder also has certain other features which make it desirable in control applications.

49.3 An Automatic Analog Computer Method for Solving Polynomials and Finding Root Loci - L. Levine and H. F. Meissinger, Hughes Aircraft Co., Culver City, Calif.

Various analog computer techniques are available which provide the means for rapid solution of polynomials with an accuracy suitable for engineering purposes. Methods heretofore described in the computer literature, however, have the shortcoming of requiring a step-by-step procedure for finding the roots.

In this paper a new analog technique is discussed by which the roots are determined automatically. This is an application of the "method of steepest descent". A suitably chosen function W is minimized in the computer by a continuous adjustment of the coordinates of a point in the complex z plane until a stable equilibrium is reached. This corresponds to a root of the polynomial. In a polynomial of nth degree n such equilibrium points can be found. The coordinate adjustment follows the gradient of the function W and therefore leads to the minimum at the fastest possible rate.

The computer may be operated in two modes: 1) searching for individual roots from points arbitrarily chosen in the complex z plane, 2) tracking the roots while coefficients of the polynomial are being varied. The latter mode is ideally suited for plotting root loci in the complex frequency plane.

This paper contains a discussion of mathematical and practical aspects of the steepest descent method and gives several alternative computer circuits. Illustrative examples of steepest descent paths and root loci obtained on the computer are included.

49.4 Magnetically Controlled Counters - E. A. Sands, Armonk, N.Y.

A magnetically controlled counter will be described in which the count determining circuit is a pair of magnetic cores. A simple theoretical analysis will be made using the principles of equivalent core impedance. Some practical circuits will be shown, and deviations from predicted behavior will be discussed. Methods of designing units to produce reliable counts from scale 2 to scale 16 will be indicated. Means of presetting will be pointed out, and practical limitations on the use of the device will be explained.

49.5 Systematic Tracing of Discrepancies in Analog Computers - M. Plotkin, Naval Air Development Center, Johnsville, Pa., and E. Grosswald, University of Pennsylvania, Philadelphia, Pa.

Large analog computers are for the most part used in control, or closed loop, problems. In problems of this sort an error in one location, whether due to incorrect plugging or to a faulty component, causes errors throughout the machine. Should the errors result in observed discrepancies, by comparison of the machine output with a reference solution either obtained independently or produced earlier by the same computer, it is sometimes difficult in closed loop problems to find the cause. This paper proposes a method for locating systematically the source of such discrepancies.

SESSION 52

Sponsored by the Professional Group on Reliability and Quality Control. To be published in Part 10 of the 1957 IRE Convention Record.

ANALYSIS AND TECHNIQUES FOR IMPROVED RELIABILITY

52.4 Reliability Prediction Technique for Use in Design of Complex Systems - H. E. Blanton, Hycon Eastern, Inc., Cambridge, Mass.

A relatively simple reliability-prediction technique has been developed which can be instituted during the early stages of the design of complex systems. Through the use of reliability diagrams (obtained by modifying engineering block diagrams) and basic rules from probability theory, reliability formulas for proposed designs are derived. Effects of secondary failures and variations in requirements for successful performance are included. By evaluating the reliability formulas using the best available component-reliability estimates, alternative designs can be compared and the need for redundancy or component improvement is established. An example based on an airborne telemetering system illustrates the technique.

NEW PATENTS

RAYMOND R. SKOLNICK Reg. Patent Agent
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Long Island City 1, New York

The following is a compilation of patents pertaining to computers and associated equipment from the Official Gazette of the United States Patent Office, dates of issue as indicated. Each entry consists of: Patent number / inventor(s) / assignee / invention.

January 22, 1957 (cont'd from Mar. issue): 2,778,624 / Louis D. Statham, Beverly Hills, Calif. / Statham Laboratories, Inc., Los Angeles, Calif. / An angular Accelerometer.

January 29, 1957: 2,779,538 / William M. Shanhouse, Roslyn Heights, N.Y. / - / A navigational relative motion computer.

2,779,539 / Sidney Darlington, Passaic Township, Morris County, N.J. / Bell Telephone Laboratories, Inc., New York, N.Y. / A multiple code wheel analogue - digital translator.

2,779,655 / Waldo H. Kliever, Minneapolis, Minn. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. / A graphical to digital indication converter.

2,779,871 / Omar L. Patterson, Media, Pa. / Sun Oil Co., Philadelphia, Pa. / A differentiating circuit.

2,779,872 / Omar L. Patterson, Media, Pa. / Sun Oil Co., Philadelphia, Pa. / An integrating circuit.

Feb. 5, 1957: 2,780,408 / Loring P. Crosman, Wilton, and Francis B. Hannon, Milford, Conn. / Sperry Rand Corp., Del. / An electronic accumulator for adding and subtracting received digit values.

2,780,409 / George A. Haidenbergh, St. Paul, Minn. / U.S.A. / A binary accumulator circuit of the parallel type.

2,780,410 / Rolland N. Bued, Clifton, N.J., Willard B. Groth, Bronx, N.Y., Gordon C. Irwin, Fair Haven, and Lindley A. Kille, Morristown, N.J., and George Riggs, Port Washington, N.Y. / Bell Telephone Laboratories, Inc., New York, N.Y. / A tape - to - card convecter circuit.

2,780,455 / Howard F. Devaney, Albuquerque, N. Mex. / U.S.A. / A combination of acceleration sensing and integrating means.

2,780,672 / Johannes Anton Greefker and Piet van Tilbuy, Eindhoven, Netherlands / Hartford National Bank and Trust Co., Hartford, Conn. / A device for separating synchronizing pulses and signal pulses with pulse-code modulation.

2,780,673 / John B. Singel, Catonsville, Md. / Westinghouse Electric Corp., East Pittsburgh, Pa. / A phasing system.

2,780,725 / Norman L. Johanson, Seattle, Wash. / Boeing Airplane Co., Seattle, Wash. / A modulator - demodulator limiter transistor circuit.

2,780,760 / Warren E. Dion, Bristol, Conn. / Bristol Co., Waterbury, Conn. / A servo system with quick - action response.

Feb. 12, 1957: 2,781,168 / Ivan A. Greenwood, Jr., Stamford, Conn. / General Precision Laboratory Inc., N.Y. / A great circle computer.

2,781,169 / John F. Donan, Los Angeles, and Lawrence D. Hindell, Gardena, Calif. / Northrop Aircraft, Inc., Hawthorne, Calif. / Means for the electronic addition of vectors at substantially any angle.

2,781,170 / Donald F. Walker, Hollinwood, Eng. / - / An electrical computing instrument for deriving the value of an unknown quantity of a problem to be solved from three known quantities, where the latter can be represented as elements of a triangle.

2,781,447 / Burton R. Lester, Camillus, N.Y. / General Electric Co., N.Y. / A binary digital computing and counting apparatus.

2,781,482 / James L. Montgomery, Indianapolis, Ind. / U.S.A. / A balanced bridge type servo system.

2,781,504 / Michele Canepa, South Norwalk, Conn. / Olivetti Corp. of America, New York, N.Y. / A binary system capable of providing indications of the presence of a signal or of its binary complement.

Feb. 19, 1957: 2,781,967 / Rolf E. Spencer, Ealing, London, and Richard H. Booth, Beaconsfield, Eng. / Electric and Musicol Ind. Lim., Hayes, Eng. / An apparatus for evaluating the instantaneous value of cos a x where a is a constant and x is an independent variable.

2,781,968 / Pierce J. C. Chenus, Paris, Fr. / Compagnie des Machines Bull (Société Anonyme), Paris, Fr. / An addition and subtraction operating device for electric calculating machines operating in the binary system.

2,781,969 / Alexander Somerville, Birmingham, Ala. / - / An apparatus for determining the product of a pair of variable quantities expressed in input voltages proportional to the quantities.

2,781,970 / Sidney Kaufman, Houston, Tex. / Shell Development Co., Emeryville, Calif. / An electronic analog computer.

2,782,347 / John A. Herbst, Montville, N.J. / Bogne Electric Manufacturing Co., Patterson, N.J. / A fail - safe servo system.

2,782,408 / Walter W. Fisher, Pacoima, and Carl E. Sohlgren, San Fernando, Calif. / Bendix Aviation Corp., North Hollywood, Calif. / An apparatus for translating reflected binary code multidigit signals into corresponding impedance values between first and second main terminals.

(cont'd on page 37)

Forum

MAGAZINES ON "COMPUTOLOGY"

Samuel J. M. England
Columbus, Ohio

I have recently joined the staff of the Systems Engineering Division at -----, where I am engaged in making a study of the computer field. I have not previously acquainted myself with your publication, but now I have sat myself down and digested each (available) issue from the beginning to the present.

I am sufficiently impressed by the "tone" of "Computers & Automation" to be moved to write to you. You will be the best judge of my bias; my feelings are as follows:

I have for the past two years read most of the issues of "-----", "-----", "-----", and "-----". I subscribed to one of them, "-----", and receive free copies of another, "-----". My feeling about these journals is that for the most part they are rather poorly disguised efforts to get advertizing into one's hands. Though this statement is too harsh to be entirely true, the fact remains that they serve some other purpose than that which meets with my approval.

In contrast, your publication has improved rather than deteriorated since Jan. '54 (the first copy that I have). The thing that I commend is a certain evidence of courage on the part of your staff for such articles as may appear to some to be a non sequitur—for example, the article No. 2 under Forum in the Jan. 1954 issue, page 14, entitled "Shakuntala Devi, Mathematical Prodigy". In fact, when I ran across your editorial comment in April 1954, which I will quote, I was by then assured that you indeed have this intention:

"In the pages of this magazine we shall do our best to promote controversy, honorable controversy, which tries to make sure that each side of a question is expressed fairly—without calling names, attacking reputations, or hugging orthodoxy."

May you prosper in this design, though the path is fraught with difficulty.

Another policy which I detect, which in the long run will prove invaluable, is that of talking to the audience. There is need in technology and science for the Greek Dramatic mechanism of the chorus. Do not suppress the part of the chorus, for the audience need to feel that they have a representative to mediate for them in the drama.

I detect a feature which should be exploited in order to further the influence of your journal. I will cite two examples: In your January 1957 issue there is an acceptably quantitative article by Walter F. Bauer entitled "Modern Large Scale Computer System Design". This article and its kind must be made available to budding computologists to act as a bridle to their untried speculation about computers. In comparison to this, I was impressed also by what might be called a more literary article which appears in the October 1956 issue, page 37, entitled "The Pure Word of St. Euphorus", by J. W. Granholm.

In this same vein but of a more sober or scholarly nature is the article in the most recent (March and April '57) issues dealing with the History of Robots and a bibliography.

I am not entirely certain that you are directed by anything but expediency because of the lack of qualified manuscripts; but I do not believe this to be so, and therefore would congratulate you for the face that your publication chooses to display.

I hope that your journal will be able to continue carrying the spirit that is to be identified with such people as Norbert Wiener, John Von Neumann, Vannevar Bush, M. Turing, and others, who would prefer the "human use of human beings".

- END -

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NEW PATENTS
(cont'd from page 36)

Feb. 26, 1957: 2,782,985 / Edward L. Vibbard, La Jolla, Calif. / Bell Telephone Laboratories, Inc., New York, N.Y. / A tape control arrangement for a computer.
2,783,421 / Karl W. Hering, Ridgefield, Conn./ The Perkin-Elmer Corp., Norwalk, Conn. / A compensated velocity servo-loop system.
2,783,422 / Marcel Fouassin, Liege, Belgium / - / A preset servo system.

- END -

THE UNITED STATES MAILS — FIELD FOR AUTOMATIC PROCESSING OF INFORMATION

I. From The Reader's Digest, Pleasantville, N.Y.

A. Release of April 8

The Post Office system "needs mechanizing and streamlining all the way through," a Reader's Digest article, titled "Our Horse and Buggy Mails", will say in the May issue of the magazine.

This will not appear until April 23. But the publication today released a summary of the 5,000-word article by Wolfgang Langewiesche when the magazine learned that someone in Washington without authority from Reader's Digest had made the article available to certain members of Congress prior to the normal publication date.

"The present administration has begun some mechanization but we are years behind Europe," says the article which concludes with the appeal: "Let's create a modern mail system."

According to the article, which discusses Post Office methods, buildings and policies, the service "uses the same methods of gathering, sorting and delivering the mail that it did 100 years ago" and mail is now "slower than it was before World War II."

The Post Office is one of the country's top 12 enterprises in volume of business, and third in number of employees. But it steadily violates the business principle of "stay ahead of the times--or die," the article states.

"The Post Office needs money for research and development...It's asking for four million dollars this year. That's chicken feed! Especially when, for lack of research, it spends --beyond its income--half that much a day! Proportionately, the Telephone Company spends 18 times as much on research!"

Wages take 75 percent of postal costs. Mechanization would cut the costs, says the article, and enable the Post Office to stay on top of the mail flood. But instead of machines, men are used in "primitive procedures" that waste time, effort and money. "In other industries, the bigger the volume, the lower the cost," the article says. "But it's a technological law: you're supposed to work with machines--bigger, faster, more efficient machines."

Most mail sorting in this country is now done by hand, but the article suggests that much of it could be mechanized. It states that Holland began experimenting with letter sorting machines in 1928, and the Dutch Post Office now has 11 such machines each sorting 50 letters per minute to 300 or more destinations as opposed to 25 per minute to 50 destinations by hand.

New buildings in new locations--on the outskirts, near airports--are needed, with midtown buildings concentrating on local mail moving only a few blocks between sender and addressee. Helicopters could lift whole trailers full of mail between sorting plants and downtown locations.

Whether mechanized or not, the article says, a post office building should be "a sort of factory." It should be tall, so the mail can flow down from floor to floor, or else, it should be flat with a floor plan in which conveyor belts can fan out like railroad tracks in a freight yard.

Instead, the article points out, we have "a Greek temple, or a best a First National bank" and many post offices date from the last century. Many were built during the depression "when the idea was to make more work" and designed "mostly to express the majesty of the federal government."

The article ends by stating that "in the 20th century even this wealthy country can't subsidize 19th-century mail systems indefinitely."

B. The first part of the Article: "Our Horse and Buggy Mails"

By annual business done--three billion dollars--the U.S. Post Office ranks among America's top dozen enterprises, among such giants as Ford, General Electric, U.S. Steel. By number of employes--half a million--it ranks third, right after the Telephone Company and General Motors. It handles 60 percent of the world's mail. It has 40,000 branch offices. Every day it carries one piece of mail for every man, woman and child in the country.

This makes the Post Office one of the world's biggest industrial operations. But between real business and Post Office business there is one big difference:

Every American business knows that it must stay ahead of the times--or die. This is the principle that has brought us from the hand workshop to the automatic factory. Today we are in the age of the jet, of lightning communication, but the Post Office is not with us. It still plods along, horse and buggy fashion. It uses the same methods of gathering, sorting and delivering the mail that it did 100 years ago. The result is something close to chaos.

The mail is slower than it was before World War II. A letter often takes 48 hours to travel 100 miles. One letter, mailed Tuesday morning, was not received seven miles away till Thursday afternoon. Circulars in New York City go undelivered for as long as ten days. A letter mailed in New York Wednesday noon took until Monday afternoon for delivery in Chicago. A letter to Chicago mailed from Glencoe, 18 miles distant, took three days. A few years ago residential mail deliveries were cut to one a day. So now, if a letter misses connections by a minute, it misses by 24 hours.

The Post Office is floundering in a sea of mail that gets deeper every year. Postal volume has risen steadily in the last 20 years. (It has doubled in New York City.) This is a flood situation; it calls for swift and basic action. The Post Office has tried to keep pace, but despite its efforts it keeps falling behind. And the price we pay is staggering. The Post Office is spending two million dollars a day more than it receives in revenue.

Even old-fashioned, slow-going Europe has kept pace better than we have. In London, to speed the handling of the mails, the Post Office has its own subway, from one end of the city to the other. A housewife can mail her grocery order in the morning and get stuff delivered the same day. A week-end guest's bread-and-butter letter arrives so promptly that an American exclaimed: "He must have mailed it before he came!" A letter mailed in Paris before 6 p.m. is delivered the next day anywhere in France. When it is necessary to catch the early local trains departing from provincial centers special mail planes fly it at no extra charge. In Munich you can get a special-delivery letter to anybody within an hour.

Our Post Office performance also contrasts strangely with private enterprise here at home. United Parcel Service--the firm that delivers packages for retail stores--also has a service for wholesalers. It sometimes charges less than the Post Office would to take the same package to the same address. Further, it picks up at the sender's. It promises a delivery date (the Post Office doesn't). It makes three attempts at delivery (the Post Office makes only one). It throws in $100 insurance, free. And it makes a profit, and it pays taxes! (On parcel post the Post Office just about breaks even.) You might say--yes, but the United Parcel picked the juiciest part of the parcel business. Not so. They have to fight urban congestion. Besides, they have just started to serve two entire states, Illinois and Massachusetts, from metropolis to the quietest back-country farm. It recently started a coast-to-coast air parcel service--at half the rate of air parcel post! Also, at rates comparable to ground parcel post, it airlifts parcels coast-to-coast on a space-available basis in four days, beating the U.S. Mails by a week!

Why is the Post Office so far behind the times? The reasons are many ....

II. From Arthur E. Summerfield, The Postmaster General, Washington, D.C.

A. Form letter of April 18

Dear Postal Patron:

The President has asked me to reply to your telegram concerning our postal problem.

The attached press statement announcing the resumption of service, with the accompanying fact sheet, will, I trust, answer some of your questions.

Thank you very much for your interest in this all-important subject.

B. Excerpts from Release of April 16

I am happy to announce the resumption of normal mail service and gratified to have the overwhelming affirmative vote of the Congress giving the Department funds for this purpose.

The legislation passed yesterday by the House and this noon by the Senate gives the Post Office Department $41 million for its operations through June 30.

Within 24 hours mail service will be back on nearly the same basis it was prior to the issuance of our Order last Friday. ....

The need for supplemental appropriations is common and often unavoidable in the Post Office Department. In the past 20 years they were needed in all except 3 years during which the present postal administration returned $235 million of unspent money to the

(cont'd on page 43)

This form was used for our March survey. See page 8.

SURVEY — ESTIMATE OF THE COMPUTER MARKET

The computer field contains many hard-to-answer questions, which can be partly answered through surveys. The purpose of this first survey being made by "Computers and Automation" is to form an estimate of the size of the market for computers, data processors, and related equipment. Following is the inquiry form for this survey. The response of any person who considers himself in the computer field is welcome, and will be much appreciated. The form may be torn out of the magazine, or may be copied on any piece of paper. We hope that the results when published will be of use to all our readers.

ESTIMATE OF THE MARKET FOR COMPUTERS AND DATA PROCESSORS

Questions

1. What kinds of computer products and services does your organization buy or rent (or is considering buying or renting)?

Computers	Yes	No
- automatic digital computers?	( )	( )
- automatic analog computers?	( )	( )
- simulators?	( )	( )
- other data processing machines?	( )	( )

such as: ____________________

____

Components	Yes	No
- delay lines?	( )	( )
- magnetic tape devices?	( )	( )
- transistors?	( )	( )
- other components?	( )	( )

such as: ____________________

____

Services	Yes	No
- computing services?	( )	( )
- consulting services?	( )	( )
- other services?	( )	( )

such as: ____________________

____

2. Can you estimate (roughly and approximately) about how much your organization is likely to spend on products and services in the computer field

- in the next twelve months?
  between $__________ and $__________

- in the next five years?
  between $__________ and $__________

3. What perplexing questions or subjects would you like us to inquire about in our surveys?

____

____

____________________ (attach paper if needed)

4. Any remarks? ____________________

____

And for statistical purposes: Your department?

____

Your chief job responsibilities? ____________________

____

Do your recommendations affect purchases?

____

Your organization's main products? ____________________

____

No. of employees? ____________________

Filled in by: Name ____________________

Title ____________________ Date __________

Organization ____________________

Address ____________________

____

When completed to the extent you conveniently can, please return this survey form to E. C. Berkeley, Editor, Computers and Automation, 815 Washington St., Newtonville 60, Mass.

(cont'd from page 19)

and has become known as a swift source of electronic computer components (within the lines that it covers). Its speed derives from its original idea, the structure of its organization, the system of inventory (which does not use automatic data processing machinery), and its experience.

For example, a large Chicago company called one morning for some special connectors needed at once to complete work on an experimental computer for the government's guided missile program. Customarily each day's orders are processed by 3:00 p.m., but since this was an emergency, the complete order, filled out of stock on hand, was delivered to LaGuardia Airport in time for the 11:00 a.m. plane to Chicago. The flight number was telegraphed via Western Union Desk Fax, and the purchaser picked up the material at the Chicago Air Terminal about 2:00 p.m. Chicago time. Before the day was over, the connectors were being installed, and the delay was eliminated.

Again, a short time ago, a call from Bourns Laboratories in California came in, to verify the supply of a particular item, a trimpot. It turned out that General Precision Laboratories of Pleasantville, N.Y., was holding another long distance line to the Bourns factory, while Bourns phoned Schweber. Schweber, with an ample stock of the particular trimpot needed, was able to send the whole order to Pleasantville immediately.

Bourns Laboratories said, 'We feel that Schweber Electronics is an outstanding example of a new type of distributor in the electronics field. These distributors handle relatively few lines and carry very complete stocks. This allows each person in their organization to spend a greater amount of time in acquiring and disseminating knowledge of each particular line. We feel that the company has established a national reputation for always having any particular item in the lines that they handle."

The company in fact acts as a warehouse for its customers, reducing their investment in inventory, storage space, and maintenance, and their risk of obsolescence of components due to rapid change in design.

When tantalum capacitors were first developed, only a few types had been manufactured. But it appeared to the company that the aircraft and guided missile field would soon require a new high temperature capacitor. So they placed their own order for an additional 100 types in the high temperature range to meet this forecasted need. The investment was made in a new line with no known demand and no real assurance that demand would develop. Delivery at the time of the company's order was five months.

Tantalum capacitors are now an integral part of every guided missile. For a time, the company was the only source of supply that could, from stock, deliver high temperature tantalum capacitors when suddenly demanded by industry. Accordingly, many prototypes for important defense projects were completed without five months of delay.

Ninety-eight percent of the company's business is conducted by telephone. There is no switchboard; calls go directly to any of the eleven sales specialists, who are trained to handle at once any and all customer requirements. This sales staff know their ten lines (made up of ten thousand different items), and are able to make recommendations to engineers as to the correct component for their need.

The company maintains an apparently crude but effective and quick inventory control. With a glance at the card record, the stock on hand of any particular item is revealed, also how many are on order, when material is due in, how many units are committed by previous orders, and which customers use this item. Therefore, a customer placing an order, can be told at once how soon he can expect delivery in order that his engineers may schedule the production accordingly. There are no "runners" or "stock men". Each salesman posts the running record on the inventory card. Since his relationship with his customers depends on his accuracy, this record stays accurate at all times.

Two large punch card manufacturers were both asked to improve the inventory control, and were requested to investigate. After analysis, they said they could not. The reason basically is the up-to-date-ness of the entries made by the actual man who deals directly with the customers -- with no intervening key punch operators, supervisors of key punch operators, etc.

The volume of business at the company has doubled each year for the past three years. To better meet the growing need of the computer and missile industry, the company plans to build a new plant and also establish a west coast branch.

(cont'd from page 23)

have found it more economical to run the computer until it breaks down before calling for the engineers. It seems obvious, however, that this practice could not be tolerated in our system.

The mere availability of "backup" or reserve equipment does not provide insurance. Since the computer in our system functions as the nerve center of a complex communications network, it will generally be impossible to transfer operations to another machine at a distant location without severely disrupting the information flow. However, commercial teletype lines and neighboring printer units can be utilized as temporary replacements for certain system components.

A fundamental requirement in our system design is the provision of means for human intervention. Intermittent failures in system components are to be expected; their functions must be performed during the interval necessary to correct and replace the mechanical faults. At present, an intelligent human being is the surest substitute and the safest means of providing against the varying and complex difficulties that can arise. Accordingly,it is necessary to provide the mechanical system with a capable and trained operating staff. This staff must be thoroughly aware of precisely what the system is accomplishing so that it can immediately introduce the correct remedial steps in case of failure. We have found it wise to run periodic "alerts" in which a variety of failures are simulated and the proper countermeasures are promptly initiated.

Application of the principles of automatic control to the operation of business organizations presents an exciting opportunity. Commercial data processing systems designed to utilize these techniques will assume responsibility for the direction and control of all routine daily functions. The use of comprehensive communications networks will enable a central data processing unit to exercise effective supervision over operations of the entire organization. The incorporation of feedback loops in the system will provide a means of notifying the data processing center of the results of earlier activities. Management reports will be abstracted from the flow of daily information, thus providing the executive with an accurate analysis of the current situation.

As such real time business systems assume more overall responsibility and control, an even greater stress must be placed on the reliability of their operation. For failure in these systems implies not just delay and annoyance but almost complete paralysis of activity. It is imperative that extreme care be exercised in the design and operation of on-line systems so that all component failures are provided against. Only in this fashion will we be adequately assured that the possibility of total failure has been eliminated and that operations can be safely entrusted to the system.

- END -

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Forum

ANALOGUE COMPUTERS IN EUROPE

P. A. R. Wright
Short Brothers & Harland Ltd.
London, England

We were interested to read in the February edition of "Computers and Automation", the article by Everett S. Calhoun on "New Computer Developments Around the World".

Whilst his article was extremely well informed, we were surprised to note that it was confined almost exclusively to digital computing equipment with little reference to progress in the analogue computing field.

The use of Analogue Computers in Europe is increasing remarkably, and is a subject which we think you should mention in future editions of your Journal. Such Analogue Computers are in use in all aircraft companies in this country and in several of the aircraft firms in France. We ourselves are using eight computers of the type described in the enclosed brochure, and twenty-seven computers of this type are also employed by other aircraft firms in this country, by Fiat Mirafiori in Turin, Italy, by the National Luchtvaartlaboratorium, Amsterdam, by the Technische Hochschule, Braunschweig, Germany, and by Stenhardt Ingeniörsfirma AB in Stockholm.

In Mr. Calhoun's article there is mention of Darmstadt Technische Hochschule which is regarded as the computing centre in Germany. Although this University has been engaged primarily on digital computing techniques, there has been some considerable research there by Dipl.-Ing. W. Dehn on multiplying devices and repetitively drift-corrected operational amplifiers for Analogue Computers. Most Analogue Computer work in Germany, however, is currently undertaken by the Technische Hochschule Braunschweig, under the direction of Dr. Horst Herrmann of the Institut für Angewandte Mathematik.

As regards computer production in Germany, it is no longer true to say that the only work is in "a barn in Neukirchen-Hünfeld". Apart from our computer which is now in use in Braunschweig,there is under development by Telefunken, in Ulm, a general purpose Analogue Computer; Analogue Computers have also been manufactured by the German firm of Schoppe und Faeser and by the American subsidiary Company of Beckman Instruments, G.m.b.H. in Munchen.

We hope the above brief comments will be of some interest to your readers.

U. S. MAILS
(cont'd from page 39)

Treasury (in 1953, 1954 and 1955) out of funds appropriated to the Post Office Department by the Congress. .....

Let me say that the letters the public has sent us during the past 10 days are also appreciated. By an overwhelming majority, they have endorsed our actions and many of them have indicated their willingness to pay more postage so that they might get better mail service . .....

Q: How much does the Post Office Department spend in a year?

A: About $3 billion, 250 million. Of this amount, 78.4 percent goes for postal employees' salaries and fringe benefits, fixed by Congress; 15.5 percent for transportation of mail, set by Government agencies; 1.8 percent for rents, utilities and communication set by F.C.C. Only 4.3 percent is left for controllable expenses over which the Department really excercises any control: printing stamps, buying trucks, etc.

Three reasons why it is costing more to give the American people the mail service they deserve, expect, and pay for, are these:

1. More mail than estimated by about a billion pieces. And this increased volume of mail doesn't provide funds to operate the Post Office Department, since all revenues go directly to the Treasury Department.

2. Increased mail service to 1.3 million new homes and 250,000 new businesses.

3. Higher wages to employees as required by law.

All three of these reasons are beyond control of the Department.

Q: Are you cutting costs in the Post Office Department?

A: Yes. The Department is now carrying 20 percent more mail with fewer employees than six years ago.

Q: How many postal employees are there?

1952 -------------- 523,757
1955 -------------- 511,613
1956 -------------- 508,587

Q: How is mail volume increasing?

1952 ---------- 49.9 billion pieces
1956 ---------- 56.4 billion pieces
1957 (Est) ---- 58.8 billion pieces
1958 (Est) ---- 59.7 billion pieces

(cont'd on page 44)

COMPUTER MARKET
(cont'd from page 17)

(1) Code	(2) Type of Organization	(3) Size	(4) Recom., Title	(5) Products and Services (a) Dig.	(b) Anal.	(c) Other	(d) Comp.	(e) Serv.	(6) Likely Spending Next Five Years Between:	And:
4T3	research	L	yes, -	v	v	SO	DMTO	-	-	-
4T4	insurances & annuities	L	yes, plng off	v	-	v	DM	-	$2,000,000	$3,000,000
4T5	crystal diodes & transistors	L	no, -	-	-	v	-	-	-	-
4U1	petroleum products	vL	yes, coordn	v	v	v	MT	PS	2,000,000	4,000,000
4V1	comptg services	S	yes, supvsr	v	-	v	O	PSO	200,000	250,000
4V2	education	L	yes, prof of math	v	v	v	O	PS	500,000	1,000,000
4V3	data on water resources	L	yes, proj engr	v	-	v	O	-	500,000	700,000
4V4	advanced educ for naval officers	M	yes, prof	v	v	-	-		-	-
4V5	aero controls	vL	yes, res supvsr	v	v	SO	DTO	-	2,000,000	3,000,000
4V6	oil	-	yes, data procg anal	v	-	O	-	-	250,000	500,000
4V7	communications	vL	yes, supvsr sys & proc	v	-	-	M	-	1,300,000	1,500,000

U. S. MAILS
(cont'd from page 43)

Q: Is the Post Office Department satisfied with mail service today?

A: Of course not. It is better than it was but still not good enough.

Q: What is the Post Office Department doing to improve service?

A: It is spending over $4 million this year alone on research. It has set up an Office of Research and Engineering. It is working with 9 engineering firms and the Bureau of Standards. It is developing mechanical and electronic devices to speed mail through post offices. Over 1500 obsolete post offices have been replaced in the past four years with new ones built by private capital. Our objective is next day delivery of mail anywhere in the United States

- END -

Forum

ASSOCIATION FOR COMPUTING MACHINERY MEETING

J. F. Summers
The Texas Company
P. O. Box 2332
Houston 1, Texas

The Twelfth Annual Meeting of the Association for Computing Machinery will be held at Houston, Texas, on June 19-21, 1957, on the campus of the University of Houston at Houston, Texas. The program will be printed around May 1, and may be obtained by writing Association for Computing Machinery, 1957 Meeting Headquarters, University of Houston, Cullen Boulevard, Houston 4, Texas.

* ——— * ——— *

ADVERTISING INDEX

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose, the kind of advertising we desire to publish is the kind that answers questions such as: What are your products? What are your services? And for each product: What is it called? What does it do? How well does it work? What are its main specifications?

Following is the index and a summary of advertisements. Each item contains: Name and address of the advertiser / subject of the advertisement / page number where it appears / CA number in case of inquiry (see note below).

READER'S INQUIRY

If you wish more information about any products or services mentioned in one or more of these advertisements, you may circle the appropriate CA Nos. on the Reader's Inquiry Form below and send that form to us (we pay postage; see the instructions). We shall then forward your inquiries, and you will hear from the advertisers direct. If you do not wish to tear the magazine, just drop us a line on a postcard.

* ——— * ——— *

REPLY
Paste label on envelope: ↓

BUSINESS REPLY LABEL
NO POSTAGE STAMP NECESSARY IF MAILED IN U.S.A.

4¢ Postage Will Be Paid By --

BERKELEY ENTERPRISES, INC.
130 West 17th Street
New York 11, N. Y.

FIRST CLASS
PERMIT NO 1680
Sec. 34.9, P. L. & R.
NEW YORK, N. Y.

READER'S INQUIRY FORM
Enclose form in envelope: ↓

READER'S INQUIRY FORM

Name (please print)..........

Your Address?..........

Your Organization?..........

Its Address?..........

Your Title?..........

Please send me additional information on the following subjects for which I have circled the CA number:

1	2	3	4	5	26	27	28	29	30	51	52	53	54	55	76	77	78	79	80	101	102	103	104	105	126	127	128	129	130
6	7	8	9	10	31	32	33	34	35	56	57	58	59	60	81	82	83	84	85	106	107	108	109	110	131	132	133	134	135
11	12	13	14	15	36	37	38	39	40	61	62	63	64	65	86	87	88	89	90	111	112	113	114	115	136	137	138	139	140
16	17	18	19	20	41	42	43	44	45	66	67	68	69	70	91	92	93	94	95	116	117	118	119	120	141	142	143	144	145
21	22	23	24	25	46	47	48	49	50	71	72	73	74	75	96	97	98	99	100	121	122	123	124	125	146	147	148	149	150

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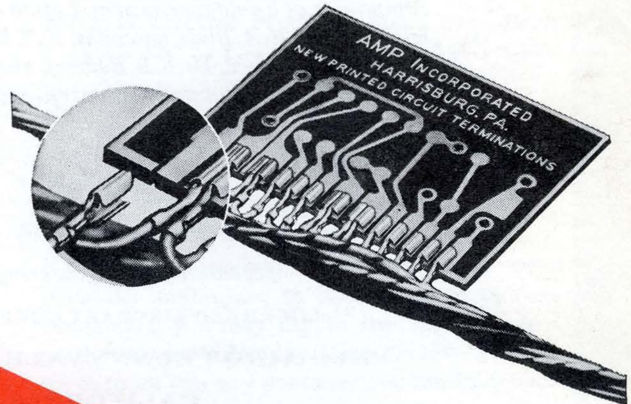


The new AMP-Edge Connector gives you . . .

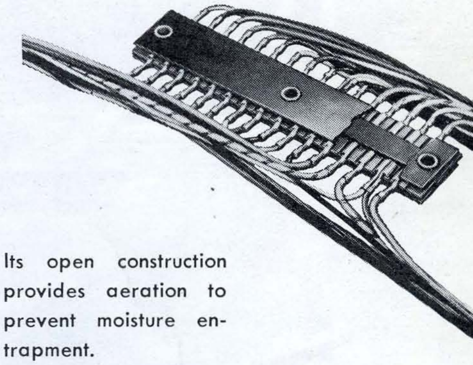
. . . **greater flexibility**—your printed circuit area and completed unit are not limited by the size of connection, as found in alternate methods of edge connection.

. . . **greater design versatility**—they can be applied in any arrangement to any section of the perimeter of the printed circuit.

. . . **two-way cost reduction**—production time and labor costs are reduced through solderless termination of the connector to the wire (4,000 terminations per hour) and the ease of applying the Edge Connector to the printed circuit.

Amp's Creative Approach
TO BETTER WIRING

Another of the many unique designs made available by the AMP-Edge technique is the new, low-cost, compact AMP-Edge Connector Block. It allows freedom of arrangement, with small area displacement.



Its open construction provides aeration to prevent moisture entrapment.

For more information on AMP-Edge Connectors, contact:

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