COMPUTERS
and AUTOMATION

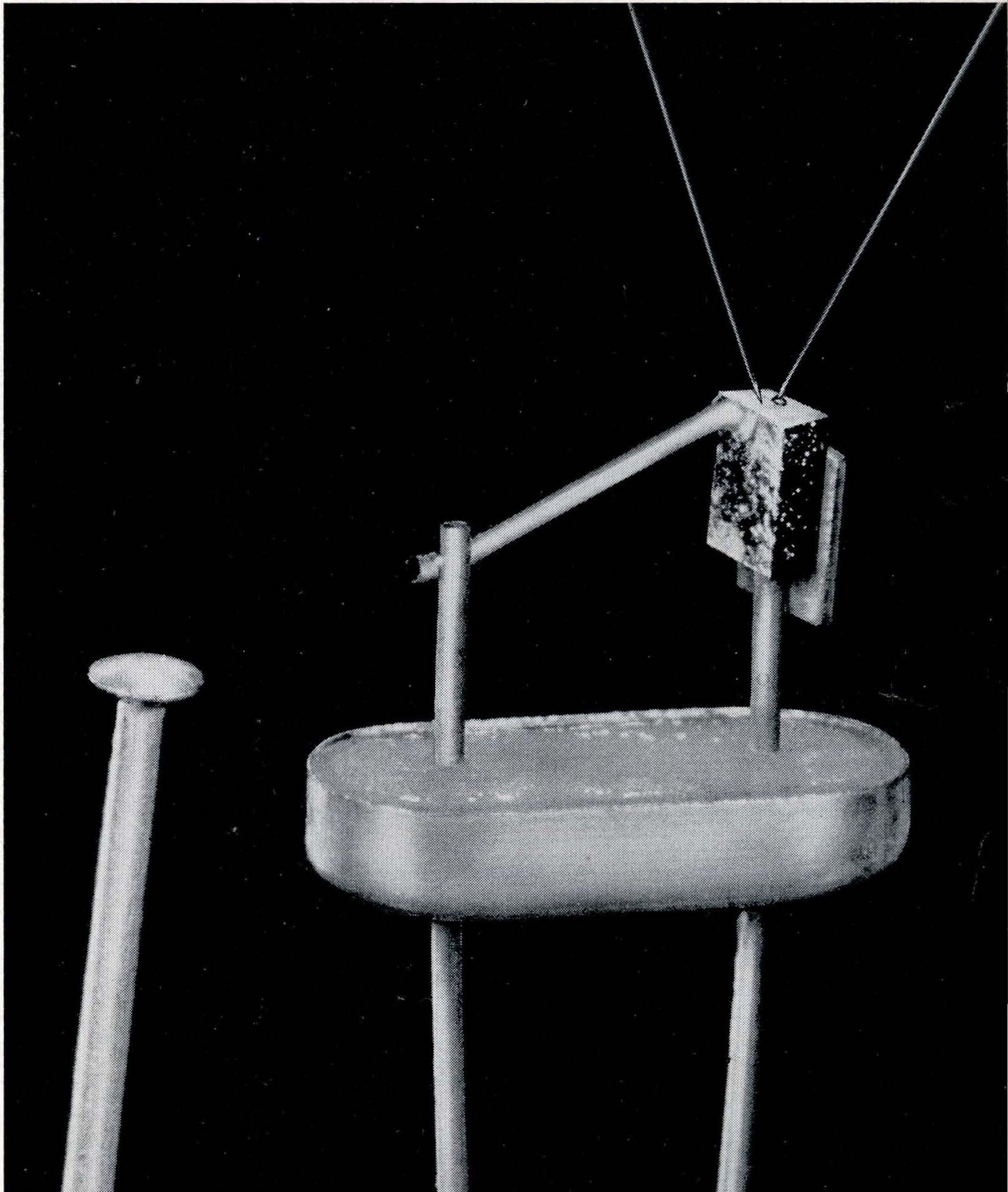
DATA PROCESSING • CYBERNETICS • ROBOTS

AUGUST 1957

The Spacistor — a New Kind of Semiconductor Amplifier

Airline Automation: A Major Step

The Role of Computers in High School Science Education



Vol. 6 - No. 8

The Editor's Notes and Readers' Forum

INDUSTRY NEWS NOTES

THERE IS a good deal of news about companies in the computer field, and several of our readers have told us in vigorous language that we should publish the news. So, in this issue we publish the first instalment of "Industry News Notes."

As usual, we invite our readers to send us information for publication when it is of general interest, and to send us corrections, revisions, and additions.

FRONT COVER: SPACISTOR

THE FRONT COVER picture is a photo of an assembly of an experimental **spacistor** (see the story in this issue) made at Raytheon Mfg. Co., photographed together with an ordinary pin (at the left) to show the miniature scale.

The leads of the spacistor are: upper left, **injector,** with point contact; upper right, **modulator,** with fused contact; bottom, **collector,** a thick broad contact; slanting crossbar at left, **base** with fused contact. The spacistor in the picture is attached to a small transistor mount shaped something like a boat.

A voltage, applied to the injector, causes electrons to enter the region of high electric field (caused by voltage applied between the base and the collector in such a way as to produce a high electric field but virtually no current). The electrons flow extremely rapidly to the collector contact. This current (flow of electrons) is modulated by applying a signal to the modulator. The modulator draws only a negligible current, but causes the current between the injector and collector to vary greatly. Thus the spacistor is an amplifier.

SCIENCE FICTION ABOUT COMPUTERS

WE HAVE just about decided not to publish any more science fiction about computers in the regular issues of **Computers and Automation.** The reasons are these. First, the readers who do not wish to have science fiction in the magazine apparently outnumber those who like it. Second, some prospective advertisers or their agencies appear to feel that they do not wish their advertising to appear in a magazine which publishes science fiction, no matter how worth while it may be. Finally, and much the most important, more and more nonfiction of undeniable importance to computer people is pressing for publication upon the space available in the magazine.

Nevertheless, sound scientific speculation about future possibilities of computers, expressed in the medium of science fiction, is important and useful to many computer people. And we hope that we may be able to publish, from time to time, an extra number of **Computers and Automation** devoted to good science fiction about computers.

Please tell us what you think.

PREPRINTS AND PUBLICATION

I. From Eric A. Weiss,
Chairman, Computer Committee, Sun Oil Co.
Philadelphia 3, Pa.

AS CHAIRMAN of the Preprints Committee of the Thirteenth National Meeting of the Association for Computing Machinery, I have the duty of assembling and distributing preprints of the papers to be presented there (Urbana, Ill., June 11-13, 1958). In doing this, I will be asked by some speakers whether or not a paper which appears as a preprint will be barred on this account from publication in your journal. In order to clarify the matter, I should like to have a brief statement of your policy in this regard.

The following details concerning the preprints may have some bearing on the matter:

The preprints will not include all papers to be given, since speakers are under no compulsion to submit their papers for preprinting.

The preprints will be distributed to those who register for the meeting, either free or at a small fee.

The preprints will be available for a limited time after the meeting to anyone for a fee.

II: From the Editor

THE FACT that a preprint of a paper has been distributed at a meeting makes no difference whatever to publication in our magazine. If the paper is one suitable for publication in **Computers and Automation,** we shall be glad to consider it for publication, irrespective of the preprint. The existence of preprints, however, will make it easier for us to seek out a paper that we would like to publish, provided the author does not prefer to have it published elsewhere. In addition, the availability of the preprints will be very helpful to many people in the computer field.

THE EFFECT OF MISSILES ON COMPUTERS

A PREDICTION by "Business Week", based on research done at the Pentagon, anticipates that half of all spending on air weapons by 1961 will be for missiles. Missiles now account for something less than a third

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THE SPACISTOR—A NEW KIND OF SEMICONDUCTOR AMPLIFIER

Neil D. Macdonald

New York, N. Y.

I. Computing A Hundred Times Faster?

ON July 16 in Boulder, Colorado, Dr. Herman Statz, Dr. Robert Pucel, and Mr. Conrad Lanza of Raytheon Manufacturing Co. gave a paper at the session on semiconductors of the Institute of Radio Engineers and the American Institute of Electrical Engineers. The paper announced a device which they called the "spacistor". This name denotes a semiconductor amplifying and switching device which makes good use of a new effect, the creation of a high electrical space charge in what was previously a transistor. The word "spacistor" is not a proprietary name but a proposed scientific term.

About eight to ten laboratory models of spacistors have been constructed, and they work; and the evidence is good that spacistors will work in many kinds of new applications, giving new powers to electronic equipment including computers.

Although the existing models have been tested only up to about 800 kilocycles, there is excellent evidence that spacistors will work at frequencies up to 100 to 10,000 megacycles. The device itself and the theory of the device together suggest that the speed of pulses in computers for calculating purposes may be raised from a million pulses per second to 1000 million pulses per second. If even a part of this promise is realized, it means that a dramatic new gain in speed for computers is about to be seized.

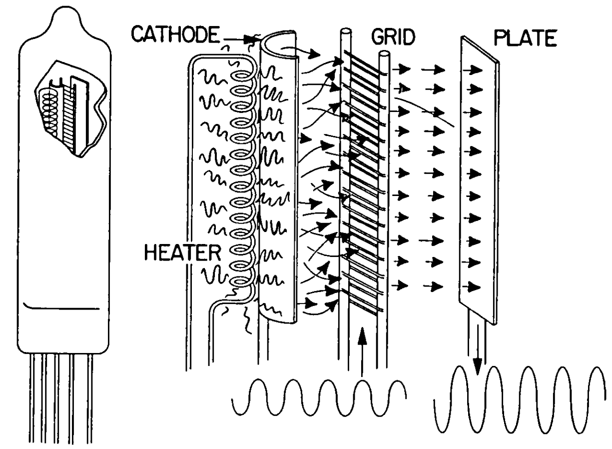
The spacistor is almost certainly a step forward in the art of amplifying electronic energy. It is expected to combine many of the best features of the properties of the transistor and the vacuum tube. It is as tiny as a transistor, and operates on the same miniature power requirements, far less than those of vacuum tubes. It is predicted that the spacistor will amplify at frequencies up to 10,000 megacycles, considerably higher than will transistors.

Also, spacistors can be made of materials unsuited for transistors, and are expected to operate at temperatures as high at 500 degrees centigrade, or more than double the operating temperatures of today's germanium and silicon transistors.

The spacistor is the outcome of two years of intensive research, and may take three to five years more research and development before it is commercially available.

II. Comparison of the Vacuum Tube, the Transistor and the Spacistor

In a vacuum tube (see the diagram), the cathode is heated by a filament heater. A large number of electrons boil off the negative cathode and are attracted to the positive plate. The small fluctuating signal, to be amplified, is applied to the negative grid as shown. This

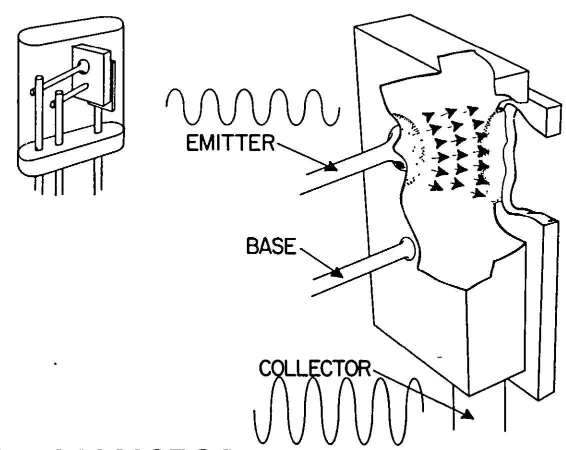


VACUUM TUBE

causes the negative grid voltage to fluctuate accordingly. The more negative the grid the smaller the current (flow of electrons) between cathode and plate. The more positive the voltage on the grid, the larger the current between cathode and plate.

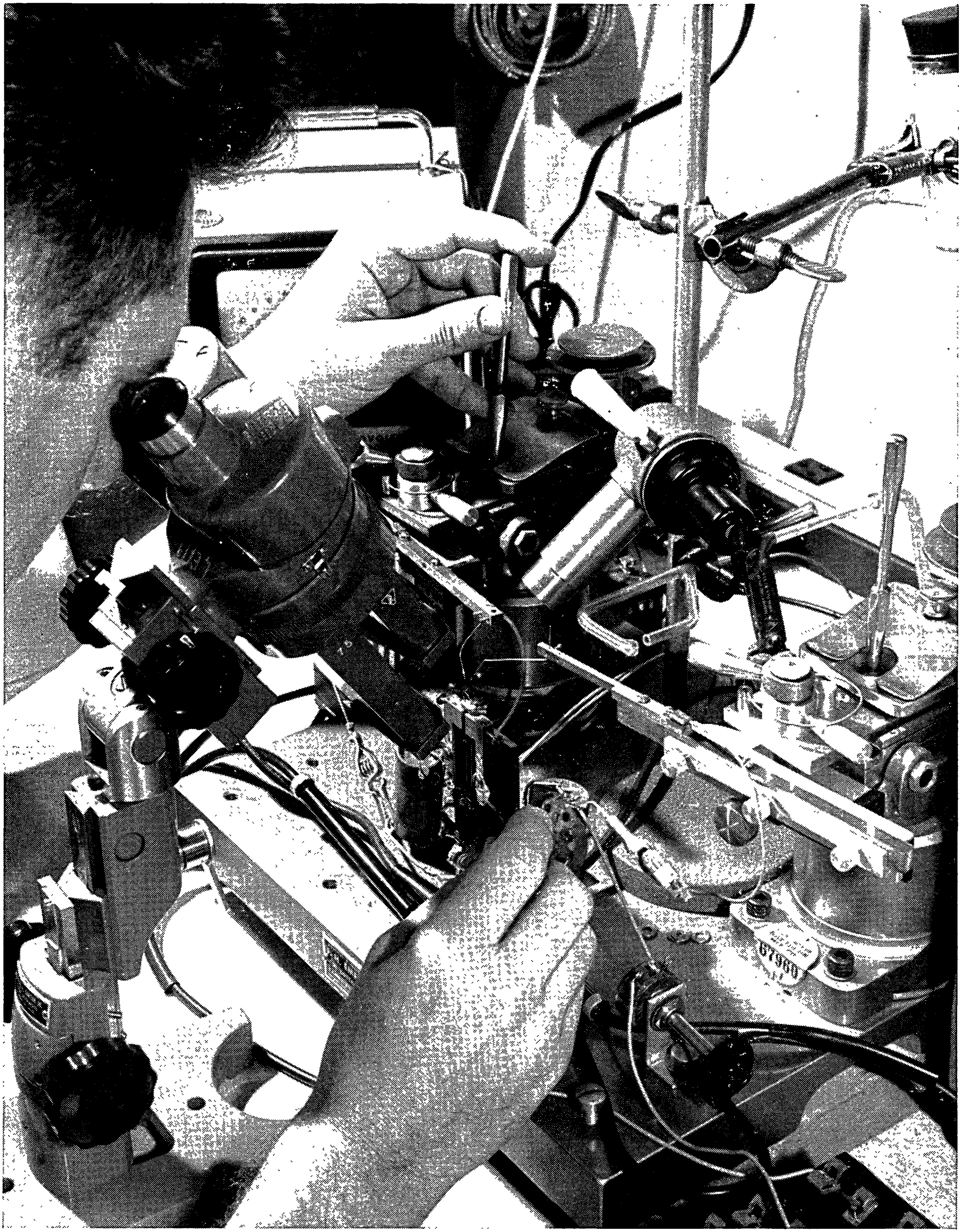
Thus the grid acts as a valve or shutter, a very small signal controlling a relatively large current. The large output signal (shown under plate) is the amplified counterpart of the small input signal. In some vacuum tubes, the choice of voltages and other factors may yield a signal gain of several thousand.

In a typical transistor of the type called n-p-n grounded base (see the diagram), a steady negative



TRANSISTOR

voltage is applied in a circuit from the emitter to the base contact, and a greater steady negative voltage is applied in a circuit from the base contact to the collector. This causes significant currents (flows of electrons) from the emitter into the base region and from the base region into the collector, because of the close



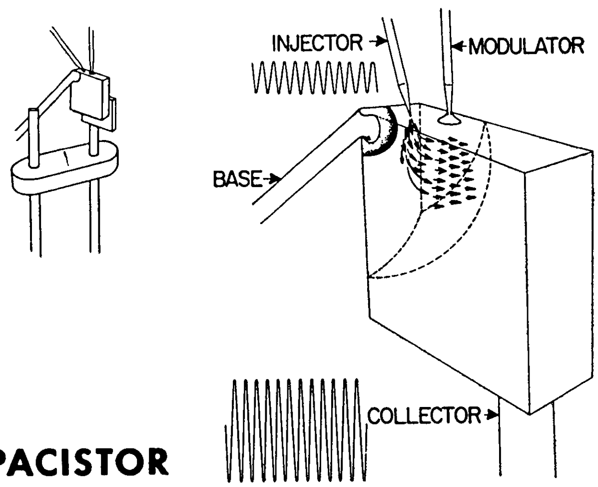
Working on Experimental Spacistors With a Micromanipulator

The machine shown here enables small objects to be moved and handled under high magnification. The left hand of the operator is on the left handle of the machine, but the right handle of the machine is not at present being manipulated. Under the binocular microscope the position of the left whisker lead to the spacistor (the injector) is being adjusted. The spacistor can almost be seen under the binoculars, where the light tube can throw light on it.

spatial proximity of the emitter and the collector; but the current from the base contact to the collector is negligible.

A small negative voltage as a fluctuating or switching signal may now be applied in the circuit from the emitter to the base contact; this signal produces a greatly multiplied fluctuating or switching signal from the base contact to the collector. Because the input current from the emitter into the base region is just about the same as the current from the base region into the collector, yet the resistance from the emitter to the base region is only a fraction of the resistance (say 1/30 to 1/100) of the resistance from the base region to the collector, a power gain of 30 to 100 times results. In this way the transistor amplifies.

In a typical spacistor (see the diagram), a high steady negative voltage is applied in a circuit through the load from the base to the collector, in such a way as to produce a high electric field but almost no current. Then a steady negative voltage is applied in a circuit from the injector to the space-charge region. This causes electrons to enter the region of the high electric field, and flow extremely rapidly to the collector. This current (flow of electrons) is modulated by the application of a negative voltage as a fluctuating or switching signal in a circuit from the modulator to the space-charge region. The choice of voltages may make the greater current from the injector to the collector 3000 times the smaller current from the modulator to the collector; and the gain factor may rise considerably. In this way, a spacistor amplifies.



SPACISTOR

III. Technical Description

The purpose of the design of the spacistor was to overcome the frequency limitations of the transistor by avoiding the slow diffusion of charge carriers (electrons or "holes") through the base region. Carrier motion accross the base region of a transistor is slow because this region is essentially free of an electric field. It is true that the base region of a diffused transistor has a built-in field, but its strength is severely limited. Very much higher field strengths, however, are found in space-charge regions in reverse-biased junctions; in fact, the strength of an electric field is limited only by the break-down voltage of the semiconductor body. The spacistor makes use of these high fields to accelerate the charge carriers so that their transit time is greatly shortened.

A typical experimental spacistor is shown schematically in Fig. 1. The semiconductor body is a reverse-biased **p-n** junction with a space-charge region **sc**. Injector **I** and modulator **M** are the input points; base **B** and collector **C** are the output points.

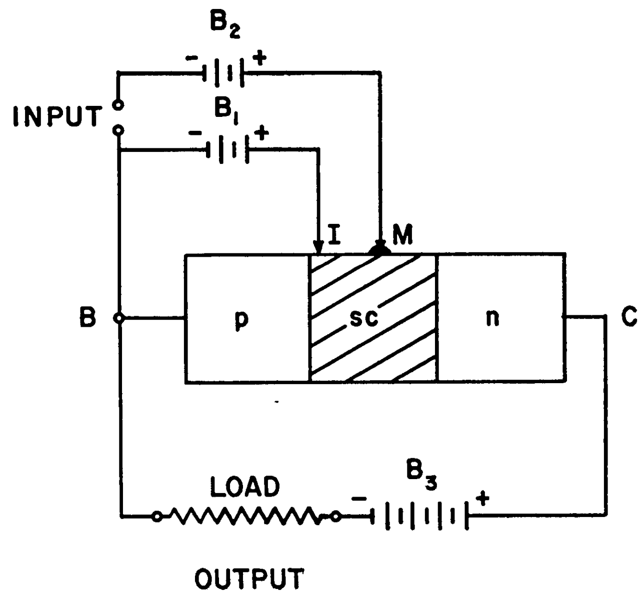


Diagram of a typical experimental spacistor and external circuits. Definitions: B, base; I, injector; M, modulator; C, collector; p, positive region; n, negative region; sc, space-charge region; $B_{1,2,3}$, battery no. one, two, three.

Injector **I** is connected to base **B** through battery B_1 which biases **I** negatively with respect to the underlying space-charge region **sc.** (Note that the potential of point **I** is still positive with respect to point **B.**) Electrons are emitted from **I** into **sc,** and the emission is space-charge-limited.

Modulator **M** is connected to the space-charge region **sc** at a point between injector **I** and the **n** region of the semiconductor body. Since **M** is biased negatively with respect to **sc** by means of battery B_2, holes cannot flow from the **p** region of the semiconductor body to **sc;** therefore **M** draws practically no current. (Note that the potential at **M** is still positive with respect to **B** and **I.**)

Modulator **M** has two functions. First, it varies the emission of injector **I** by superimposing an a.c. voltage on the d.c. bias. The field produced by **M** penetrates throughout the space-charge region to its boundaries.

Second, modulator **M** makes the bias of injector **I** practically independent of the voltage applied across the base **B** and the collector **C** so as to keep the output impedance desirably high — in excess of 30 megohms for an injected current of 0.3 milliamperes.

Transconductance (g_m) of present experimental spacistors is considerably below that of good vacuum tubes but, with further development, it is expected that comparable values will be attained.

A low-frequency power gain of 70 db has already been achieved with experimental spacistors at low frequencies.

A comparable advantage over transistors is expected to be realized at higher frequencies as well. When the present input of 30 megohms is improved, power gain is expected to become so great that it will be more appropriate to talk about voltage gain, as in the case of a vacuum tube. A voltage gain of 3000 has already been achieved.

Output capacitance is exceedingly small because of the wide space-charge region, and values smaller than 1 micromicrofarad appear entirely feasible. Even with the relatively low transconductance values obtained in present spacistors, it is expected that tuned amplifiers can be built which will operate at frequencies corresponding to approximately the inverse transit time through the space-charge regions, i.e., frequencies in excess of 1000 megacycles.

Input and output are decoupled to a high degree as in a vacuum tube — a useful property in the design of multi-stage circuitry.

Another important advantage of the spacistor is that its operation is practically independent of the "lifetime" of the charge-carrier. It should therefore be feasible to employ not only germanium and silicon but also other semiconductor materials whose short "lifetime" makes them unsuitable for transistors. Silicon carbide and other materials with large energy gaps are promising possibilities for high-temperature spacistors.

Comparative Characteristics of the Vacuum Tube, Transistor, and Spacistor

	Vacuum Tube	Transistor	Spacistor
Frequency Limit	High (1000 Mc)	Medium (250 Mc)	High (10,000 Mc)
Heater Power	Required	None	None
High Temperature Materials	Available	Not Available	Available
Theoretical Life	Limited	Unlimited	Unlimited
Vacuum Envelope	Required	None	None
Circuit Weight and Space	High	Low	Low
Strategic Materials	Required	None	None
Complexity of Multiple-Stage Circuitry	Low	High	Low
Input and Output Impedances	High	Low	Very High

The Editor's Notes and Readers' Forum

[Continued from page 3]

of the present 8 billions spent for planes and missiles. Assuming no important change in the international situation, the same sum will go for all air arms in 1961.

This means that: a. The physical volume of units will decrease.

b. A freeze-out of aircraft producers is in prospect — particularly as procurement of fighters dwindles.

c. As missiles increase in number, value, and complexity, so does the need for computers to help design, test, control, and record them. It is probable that doubling the missile program will increase computer procurement eightfold.

COMPUTER APPLICATIONS TO POULTRY FEED

Wilbur E. Clark
Hanover, Pa.

I AM JUST back from a three-day poultry conference at Penn State University where one day at lunch I talked with the executive secretary of a millers and feed dealers association. He told me that at least two major feed companies are now using the services of these large computers in this way:

Each day they telephone to the computer service (which is retained on an hourly service basis) the closing prices at Chicago on the various feed grains and ingredients such as corn, oats, barley, soybean oil meal, etc. The computer has already stored up the various kinds of ingredients that may be substituted for each other, depending on current prices, kind of feed formula being manufactured, etc. (It's a very involved business, manufacturing a certain poultry feed with definite percentages of protein, fat, fiber, ash, vitamins, antibiotics, and all the other additives that make up a modern feed formula.)

The data are fed into the computer, and about 10 minutes later the machine types out the exact information telling which ingredients are the best buys of the day to make a particular formula feed.

This information was formerly arrived at by a corps of some 25 skilled office workers and nutritionists. As a result of the change, one feed company estimates a saving of over $100,000 a year and, besides, gets the information much faster so that it can take advantage of a price situation before it changes.

VARIABLE-LENGTH MULTIPLICATION

R. J. Margolin
Bendix Computer Division
Bendix Aviation Corporation
Los Angeles, Calif.

THE BENDIX G-15, a serial-type drum computer, has variable-length multiplication which operates along the lines suggested by Mr. I. J. Good in the February issue of Computers and Automation.

The Bendix G-15 has three double-precision (57 bits and sign) registers which are involved in multiplication and division. With the multiplicand in the ID (multiplIcand-Denominator) register and the multiplier in the MQ (Multiplier-Quotient) register the multiply command is executed. In the modified two-address form of command used in the G-15, the part of the command which controls timing contains a relative timing number (the number of word times during which multiplication is to continue). For each two word times of multiplication, one bit of the multiplier is processed. The relative timing number may vary from 2 to 114, for multipliers of 1 to 57 bits, respectively. The product is accumulated double-precision in the PN (Product-Nume-rator) register and may be taken out as either single (28 bits and sign) or double (57 bits and sign)

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AIRLINE AUTOMATION: A MAJOR STEP

C. E. Ammann
Director, Advanced Process Research
American Airlines
New York, N. Y.

THE airlines present an excellent example of a fast growing industry. As is often the case in such industries, some parts of the business took great strides while others remained practically dormant. Improvements in aircraft over the years reduced the flying time across the country from a matter of days to a matter of hours, yet only the simplest of tools were available to process the passenger's reservation.

For example, in 1931 it took three days to fly from New York to Los Angeles in the Fokker F10. In 1934, by a combination of the DC-2 and Curtiss Condor, it was possible to make this trip in 21 hours. Today, you fly it in eight hours. In another year or two, something less than five hours will be routine.

To do these things better – at less cost – and to make the eventual product more attractive to the buyer is the constant aim of every form of business enterprise. Air transportation is no exception. Our customer, the passenger, must be provided with what he wants – when he wants it. We have to display our full product – we have to make it attractive – we have to make the buying process easy.

Looking at our product in 1940, we recognized that although we had made it attractive by providing new aircraft and better in-flight service, there was little in the offing to improve our reservations system.

Three-Part Problem

It was recognized that the solution to the reservations problem lay in something substantially different, or at least more advanced, than anything which had served the industry through its early years of growth. After reaching this conclusion the next step was to analyze the situation and define the problem. This was done and it was shortly concluded that making a reservation involved three distinct actions or parts:

First, determining the availability of space; second, modifying the inventory, and third, the recording of a name. It was further decided that Availability and Inventory Control were of the most immediate concern.

Availability as we use the term refers to the status of space on a particular flight. It answers the question: Is there space available, or on what flights is space available? Since our product is highly perishable and the number of items we sell are almost infinite in number, availability is highly dependent on an accurate and current inventory control system.

Our product is perishable because an empty seat on a plane that has departed can never be reclaimed. The items we sell are infinite in number because each boarding point on a trip on the fifth of the month bears little relation to that boarding point on a similar trip on the sixth of the month, and so on. The seats cannot be used for identical purposes or substituted for one another except in rare instances. Although hardly the rule, it is not unusual to receive bookings for a particular trip years in the future.

Upon examination we found that there were two general means of presenting availability information:

1. The Availability Book.
2. The Visual Display Board.

The Availability Book, as the name implies, is a book or index in which the status of space on each leg of each flight on each day is recorded. A leg, as we use the term, refers to that portion of a flight between a scheduled take-off and the next scheduled landing. One book can be made physically accessible to a maximum of four agents and it is still used in small offices. Multiple books for use in larger offices had been tried and found wanting due to errors developing through delays or negligence in posting from book to book.

This problem outweighed the advantage of having the information close to the agent and easily read, as well as the advantage of being able to quickly insert new pages to give effect to a revised order of departure caused by a schedule change.

Display Boards Tried

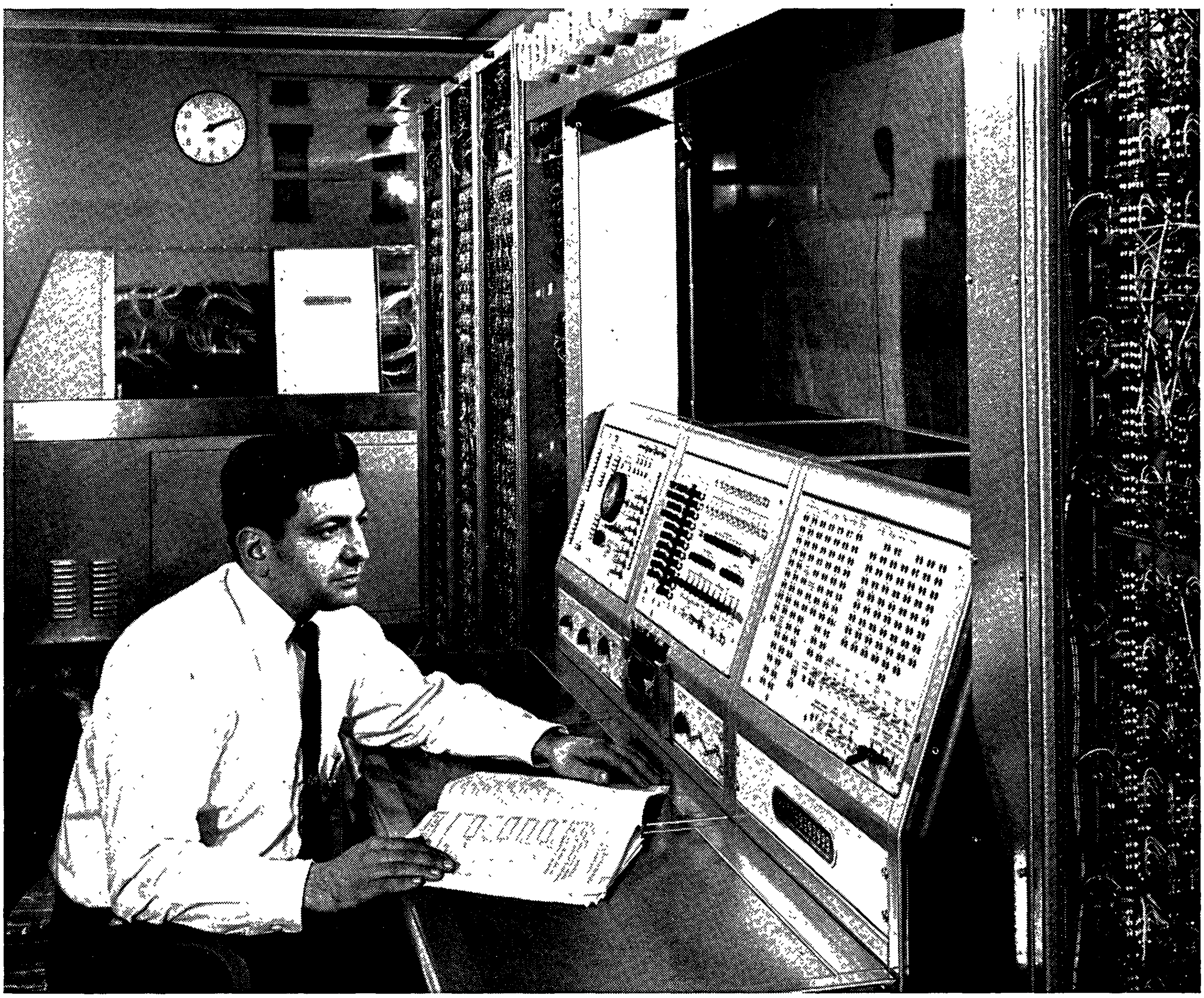
Poor experience in keeping several books in agreement led to the use of a blackboard or visual display board so that many agents might look at the same source of information. This method likewise had limitations in the number of people it could conveniently serve. Clear space to seat agents with a full view of the board was limited by the distance between columns in most buildings, usually about 22 feet by 22 feet.

The use of multiple boards to overcome this difficulty had the same disadvantage as multiple books. In addition, common visible displays presented serious growth problems.

As demand for services increased and it was necessary for more people to provide service to the customer, the size of each character displayed on the board had to be increased so everyone could see it.

As space became hard to obtain due to demand, people who might otherwise go to the airport and take the first flight available began to make reservations. This increased the calls to Reservations and required more people to answer the telephones.

This same demand caused the manufacturer, in this case the airline, to provide more planes to handle the pressure, thus increasing the amount of information to be displayed. Even with both the Availability Book and the Visual Board, agents in ticket offices had to call Reservations for information. And because of the limited amount of information that could be displayed and seen in a large office, even the reservations agent had to call a second party for some data.



Located in a room adjacent to American Airlines new reservations quarters, largest in the world, at Manhattan's West Side Airlines Terminal is the Magnetronic Reservisor, an improved version of an earlier model introduced to industry by American in 1952. Built to the airline's specifications by Teleregister Corp., a subsidiary of Ogden Corp., the new Reservisor provides the same instantaneous reservations information as its predecessor but in greater detail and faster. The "brain," consisting of the memory drum under the clock at the far end of the room and the racks surrounding the console at which the maintenance technician is seated, stores and releases information to the inquiring reservations agent at the flick of a switch.

Naturally there has been a great deal of experimentation with visual display boards. There are probably as many approaches as there are stations that use the boards.

Although slate and chalk are the most common materials used, one will see variations made of plastic, ceramic coated steel, painted wood and so forth. Preprinted plaques using both colors and symbols are used on some boards in an attempt to increase readability. Many boards are made to raise and lower or to turn on a central axis, all with a view toward making it easier to post information.

Some attempts have been made to electrify these boards but all to no avail because of the prohibitive cost.

Basic Requirements

After satisfying ourselves that reservations would be with us for some years in the future, and determining the areas we would tackle first, namely Availability and Inventory Control, we attempted to outline the basic requirements of a system.

1. We felt that the system should make our product immediately available to the sales agent without causing undue eyestrain or fatigue.
2. It should enable us to record sales and cancellations as they occur and keep an accurate running inventory.
3. It should reduce our dependence on large, auditorium-like areas for future reservations offices, and by using regular communication facilities make available to ticket offices, satellite offices or to any point such as any room, all the informational advantages one would have if seated in the reservations office.
4. The input-output device, which we later called an Agent Set, should retain a record of the last

operation until manually cleared or another transaction was entered. It should be easily operated by right-handed or left-handed people and so simple in operation that an agent could be trained in its use in a matter of an hour or less.

5. It should automatically advise other stations, when necessary, each time a given flight is sold out.
6. It should do all of the above economically, accurately, and be capable of expansion.

Our first approach naturally was to go to large manufacturers and see whether they had a device which would meet our requirements, or if they were interested in the development of such a system. Interestingly enough, we found that we were in a field where little had been done, that is the field of inventory control. Any number of organizations manufactured accounting systems but there was a basic difference between these systems and what we needed for inventory control.

In accounting, one person would have access to hundreds or even thousands of accounts or records, whereas in inventory control the situation is reversed and ideally any or all salesmen should be able to get at the inventory for a specific item. As you can see, with a perishable item like a seat on today's five o'clock flight for New York, it is necessary to handle the sale as quickly as possible. Conversely, upon receiving a cancellation it is necessary to return it to inventory immediately so that it may be resold.

Designed Own Equipment

It soon became obvious that we could not obtain a piece of equipment off the shelf so to speak and manufacturers were not particularly interested in developing new equipment to do the job. We did receive nuisance quotations to develop such a system, but actually even then there was little interest. Since the problem was not likely to be solved unless we did something about it, we decided to attempt the design ourselves. In this case we had the three advantages — knowing the problem, not knowing how it could not be solved, and a limited group of one person working on it. We were willing to listen to any idea and examine its possibilities with an open mind.

Some of our approaches were novel to say the least. One early attempt was as much mechanical as electrical, and its main purpose was to help visualize the problem. In this solution we used vertical metal tubes to hold marbles. Each tube representing a flight on a particular day and each marble a seat. By means of an electric trip at the bottom of each tube, marbles could be released representing seats sold. Marbles could be returned from the top to represent seats cancelled. The height of

In a setting designed for comfort, speed and service, two American Airlines reservations agents at the airline's new reservations office at Manhattan's West Side Terminal provide the answers to AA customers. An agent's key set, which is linked to the Magnetronic Reservisor, is placed conveniently between them and other useful information is quickly available on glass-enclosed charts at eye level.

marbles in the tube represented the number of seats in inventory. Admittedly, this was not the machine we wanted but it would work and it served to give us a better understanding of the problem.

Another idea that seemed at first to show promise was to use a bridge network with fixed value resistors representing each seat. You could then interpret the number of seats by reading the voltage drop across the resistors. This was all right but when we calculated the power requirements we found that such system would consume over 100 kilowatts. This was obviously out of line.

We finally arrived at what may be called a cross-bar system using relays. A matrix was designed which had some similarity to the core memories of today, only instead of cores we had jacks into which plugs were manually inserted to indicate open or closed. Across the top indicating each vertical column were the dates, and along the side indicating the horizontal rows were the trip legs. Then using the simplest of equipment we could check for continuity between vertical and horizontal lines which would indicate that a shorting plug had been inserted meaning that the flight had been sold out.

A working model was built using parts immediately at hand; as a matter of fact, much of it was done in a basement workshop. Upon completion, the model was operated before members of top management who approved of the approach and set up a fund to further explore the idea.

Our luck seemed to change at this juncture. The Teleregister Corporation, then a subsidiary of Western Union, was contacted and after examining the operating model became interested and agreed to build a pilot model for what we considered a reasonable price.

Pilot Model in 1946

This pilot model was installed in February, 1946, at Boston and was used until we moved into our new office last year. Although the equipment was designed for use in New York, a last-minute change in plans made it necessary to place the equipment in Boston. This created a problem because the physical dimensions of halls, doorways, etc., of the New York office were considered in fabricating equipment, and in Boston it was found that we could not fit the equipment through the stair well or in the elevator. It was necessary to obtain a crane, remove an outside window on the third floor of the building, and bring the equipment through this opening.

This first installation was designed strictly for availability. It had no frills but was sound from an engineering and electrical standpoint. After the first year's operation we evaluated results and found that the station was carrying about 200 more passengers per day with some 20 less people in the office. Unfortunately, other changes had taken place in the office at the same time and we could not attribute all improvement to the Reservisor, but we were able to prove conclusively that equipment of this type was economical and it had a definite effect on revenue.

The reception by the agents was just terrific. In a very short time they had nicknamed the equipment "Girly" because it told all.

Shortly after the installation in the reservations office we placed remote connecting equipment in our Hotel Statler ticket office, where its sales aspects were really evident.

It (1946) was a war year – a time of priorities and tight space. We were continually accused of keeping seats up our sleeve. With the advent of the Reservisor, where requests for space were made and answered by a machine, this feeling completely disappeared. This, in itself, is a very important contribution of machine techniques.

With the availability problem well on the way to solution in Boston, our next problem was to handle the inventory. This problem was as much economic as technical. An example of a technical approach that never paid off was an English-made system which was loaned to one airline in New York some years ago. This system used rotary switches to do the counting. It worked well enough but it was both clumsy and costly.

Rotary Switch Not Practical

The rotary switch, in its class, is basically a high speed device designed for many revolutions per second. Applied to keeping the inventory on a flight leg for a month, this rotary switch would make less than one revolution a month – a most uneconomic use of the device.

One idea that was pursued was to build a rotary counter out of a screw and nut. A ratchet on the bottom of the screw would cause it to turn, thus moving the nut in a vertical plane. By reading the height of the nut electrically or manually, one could tell the number of seats on the plane. This approach like many others was workable, but proved expensive from a manufacturing viewpoint.

All of these proposals required systems that would cost dollars per seat leg day, while our evaluation of the project indicated that storage cost should be measured in terms of about three cents per seat leg day.

About this time, considerable publicity was released on the work of Dr. Howard H. Aiken of Harvard University. His progress with the magnetic drum was proving successful, and I believe it was his work as much as any which spurred the engineers to explore the area of a special purpose computer for both storing and counting.

Magnetronic Reservisor Evolved

Subsequently, an unused grinding wheel was fitted with a round aluminum billet and sprayed with an oxide coating. A read/record head was mounted next to this improvised drum and connected to suitable electronic circuitry which enabled the engineers to check the feasibility of this approach. It proved highly successful and step by step the Magnetronic Reservisor, as we know it today, came into being.

Now, we cannot exactly compare this work with other computer work of the time because our intent to apply these principles to inventory control slightly changed the complexion of the problem. We required absolute accuracy and 22-hour-a-day operation, which is a tall order even today. These requirements indicated a slightly different design from that of the normal computer.

For example, although packing factors of 80 or more to the inch were common at the time, we packed 20 to the inch. We used dual drums — for that matter, dual equipment throughout — and each transaction was completed in duplicate and compared throughout its cycle so that in the event an error was in the making the machine would throw out the entire transaction before it affected the inventory.

Each time a transaction was discarded the inventory was left in its original state and a red lamp signal sent to the Agent Set originating the call so that he might reinstate his call. At the same time, a teletype printer printed out a record of the transaction which had been discarded so that the maintenance group could analyze the situation. The fact that these and other safeguards worked is evidenced by the 99.8% up-time experienced with the equipment.

One problem that may be of particular interest is the design of the Agent Set. We worried over this problem for a considerable period of time examining every conceivable approach. Our problem revolved about how to put in requests for information. The passenger can tell the sales agent where he wants to go and when he wants to leave but he can seldom give you the flight number.

Secondly, the whole advantage of a reservations system to American Airlines lies in the ability to accommodate a passenger on an earlier or later flight if the one of his choice is full. Expressed in terms of Agent Set requirements, this means that the equipment should always offer an alternate or at least offer one if the specific flight requested is not available.

Using keys, buttons, dials and so forth to put in all of the information needed was too time-consuming for the agent and tended to increase the physical size of the equipment. We tried mechanized versions of the desk telephone index, drums with the information printed on a removable paper roll, endless loops of 35 millimeter film and slides of the same material which, of course, necessitated having a projector as part of the Agent Set. Each of these methods satisfied some problems and created others.

Destination Plate

Lastly, we thought of the Destination Plate which, in effect, was an automatic encoding and decoding device, eliminating the need for the agent to translate the passenger's request into machine or airline language.

To reduce the number of destination plates needed we evolved the scheme of a shutter switch which allowed us to view either of two lines of information on the plate by the flick of a switch.

The system was finally agreed upon and in July, 1952, the first Magnetronic Reservisor went into operation in New York. It has proved to be an excellent, reliable tool. Early fears of tube failure have proved unwarranted. When we installed the new, larger equipment in 1956, there were still many of the original complement of tubes operating effectively in the old equipment after more than four years of 24-hour-a-day service. I should state here that two hours a day are given to preventive maintenance.

Coincident with the work on the Reservisor we were requested to look into the problem of disseminating arrival and departure information. I don't know why we did not see the similarity to the availability problem immediately, but our first approach was to mechanize the function as it was then performed. This consisted of remotely controlled indicators which would take the place of the blackboard or other means of presenting the information. A brief look at the final design indicated that it would do the job, but at a cost that we could not justify.

We dropped the project temporarily, but kept it in the back of our minds. One balmy summer day it occurred to us that we could store the information in the Reservisor and read it from a fixed display by means of the leg-indicating lights.

Today, in addition to availability and inventory control, the Reservisor also dispenses flight information.

One Vast Network

American Airlines now has advanced models of the original Availability Reservisor located in Chicago, Boston and Washington. The New York counting Reservisor handles the entire metropolitan area and is remotely connected with Buffalo. Gradually, all the large stations will be joined together into one vast network. We will retain Availability equipment in large cities and route calls from Agent Sets to these local units for availability and information. Sell and cancel calls will be routed to one or more central inventory control units which will, in turn, update the local Availability units.

This seems to be the general pattern that is shaping up with all the airlines, and it is only a question of time when we will interconnect our services.

As I stated at the beginning, we found three major areas: Availability of the product, inventory of the product, and handling of the name record or the physical record of the transaction. I have outlined how we approached and solved the first two. During the last few years we have been working on the solution of the latter problem, that is the handling of the name record. A pilot model of the equipment to handle this situation was developed jointly with IBM and is presently in use in Buffalo. It is known as a Data Organizing Translator.

It reads the keypunched reservations record, decides whether one or more messages need be sent to other stations, if messages should be sent, it decides whether the stations are on American Airlines or another airline, and, based upon this decision, it determines the Code Directing Characters that should prefix each message in order to reach its destination.

Foresees Many Uses

It then prepares the message organizing the text for each addressee depending on that city's position in the itinerary. A local electric typewriter can produce a copy of each message sent. An additional local typewriter can produce a list of all transactions in any desired category, such as sales on other airlines, sales on flights ending or beginning in 2, etc. A punched 5 level tape is produced

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THE ROLE OF COMPUTERS IN HIGH SCHOOL SCIENCE EDUCATION

I: THE ASSOCIATION FOR COMPUTING MACHINERY and HIGH SCHOOL SCIENCE EDUCATION

George E. Forsythe
Numerical Analysis Research,
University of California at Los Angeles

(A memorandum from the chairman of the Education Committee of the Association for Computing Machinery, addressed to "approximately 100 persons who have expressed an interest in the subject")

THE Association for Computing Machinery is an international society of scientists interested in the design, manufacture, and use of automatic computing machinery. The author is chairman of the Education Committee of this Association. The purpose of this memorandum is to let you know of my interest, and that of the Education Committee, in the problems of high school mathematics and science education. The opinions expressed here are those of the author and not necessarily those of the Association's Education Committee. Your comments will be appreciated.

At the national meeting of the Association in Houston, Texas, June 19-21, 1957, the Council of the Association passed the following resolution:

> "The Council of the Association for Computing Machinery notes that better education in science and mathematics in the primary and secondary schools cannot be expected without higher salaries for teachers of science and mathematics, at least. The Council urges members of the Association, if they see fit, to work for such higher salaries in their own communities. The Council also urges members of the Association, if they see fit, to make their time and talents available to the schools of their communities for collateral educational activities."

This resolution speaks for itself. The phrase "collateral . . . . . activities" expresses my feeling that people in industry are rarely equipped to take up classroom teaching, but that they can make a contribution if they will volunteer for mathematics clubs, assembly programs, computer visits, or for any number of useful extracurricular activities to promote interest in careers in science and engineering.

Several of us in the Association have had experience in speaking to school groups and teachers. We are aware of the interesting, important, and reasonably well paid positions in science and engineering, and are anxious to let high school and junior high school students and their teachers know about these careers. We know that the number of large scale digital computing machines is going to be enormous. (Over 700 had been installed by December 1956, with over 2200 on order at that time. Within five years, I estimate that around 5000 computers will be installed.)

Each of these machines can be expected to require at least 10 mathematically trained persons at some level to assist in its use. This total of 50,000 jobs compares with today's total of less than 12,000 members in all of our mathematical societies combined. Obviously many more people will be needed. The basic source can only be mathematically educated high school students. In addition to positions dealing directly with computers, an even larger number of related positions in engineering and business will be affected materially by contact with the computing centers.

Apparently most high school students — even bright ones — are pretty cold to careers in science. (See Benjamin Fine's article, "New York Times", 9 September 1956, section I, p. 76). Surely part of the cure is for enthusiastic speakers and teachers to get young students fired up with the inherent fascination and just plain FUN of science.

Automatic computers are exceptionally well suited for this purpose, because of their ultimate simplicity. Digital computers can only add, subtract, multiply, and divide, and the junior high school student already knows these operations. Many of the further problems which arise in practical computation can be understood and appreciated by a bright ninth grader. I know of no other field of mathematical science where a high school student can thus come to grips with important and live problems on the borders of knowledge.

Of course, the staffing of computer laboratories is only one aspect of the broad national problem of science and engineering education.

Much routine clerical work can be done by machine right now, and many clerical positions will gradually cease to exist, as computers take over these roles. I consider this to be a Computer Revolution comparable to the Industrial Revolution, and therefore feel that ordinary school students — and not just future scientists and machine operators — must be made aware of the general nature of these machines.

The success of our impact on education will mainly depend on the supply of teaching materials which we can make available to the schools. It is therefore very important for qualified people to design computer kits and other materials suitable for classroom and after-hours use. This is the conclusion of Richard W. Melville, chairman of the Committee on High School Science Education of the Joint Computer Committee, as expressed in his informative report in "Education and Computers", Part 2, of the January, 1957, issue of **Computers and Automation.**

I believe that our schools cannot possibly obtain enough good science teachers at the prevailing salary scales, in the face of the current competition for scientists. However, many teachers are encouraged to remain in teaching by interesting and remunerative summer work. Our committee therefore hopes to give publicity to such plans for sharing personnel by industry and schools as have been inaugurated by the Hughes Aircraft Co. (Culver City, Calif.) and Arthur D. Little, Inc. (Cambridge, Mass.)

II. A THREE-PART APPROACH TO SOLVING THE PROBLEM

W. Eugene Ferguson

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Newton High School, Newtonville, Mass.

(Read during a panel discussion on "The Role of Computers in High School Science Education", at the meeting of the Association for Computing Machinery in Houston, Texas, June 20, 1957.)

THE role of computers in high school science education is still an unknown quantity. I hope that during this discussion today some of the most promising ideas for the introduction of computer education in the high school will be brought out.

As one reads the "help wanted" columns today (at least in the Boston area), he is struck by the heavy demand for computer personnel, from the design engineer on down to the programmer, coder, and computer operator. If the supply is to catch up with the demand, I believe there must be some computer education developed for the high school. I have singled out the computing field, but I would hasten to add that this is only one small area in the larger field of the sciences.

I shall attack this problem from three angles:

First: Teacher shortage, and its relation to programs in high school mathematics and science, and the shortage of well-trained scientists.

Second: The high school curriculum in relation to needs for scientific personnel and computer people.

Third: How industry can help in high school science education.

It is probably a safe assumption that we need more and better trained scientists, engineers, and computer personnel. To insure an adequate supply of scientists the first thing that must happen is that the high schools must be adequately staffed with qualified people in their mathematics and science departments. I say high schools, but I would like to repeat the same statement for junior high school mathematics and science departments, and even on down to the elementary schools. The junior and senior high school is where the initial stages of excitement in science start, and young people when excited need adequately trained teachers guiding them.

Inadequate Salaries

The major difficulty in getting adequately qualified and competent teaching personnel in the mathematics and science classes today can be summed up in two words, **inadequate salaries.** How can we hope to keep a staff of adequately trained teachers if their salary range is so low that it is impossible for them to make a living without having a second job after school hours? These conditions exist today almost everywhere, even among some of the recognized top public schools in the nation.

The developments in science and mathematics today are moving at such a pace that the training received by teachers a few years ago is woefully inadequate for today's modern classroom in mathematics and science. I am head of the mathematics department in a large high school; and in order for my teachers to keep pace with modern developments, they have to go back to school from time to time or at least spend their summers studying, and **not** do odd jobs to eke out a living.

The grants by the National Science Foundation for attending summer institutes are a great help. I also believe industry could employ some teachers for summer jobs in their computing and science sections, and bring them up to date with needs in mathematics and science. I believe it is still true that teachers have a tremendous influence on the likes and dislikes of students for various subjects. Many potential careers in mathematics and science are killed by inadequately prepared, unhappy, and underpaid school teachers. Up until now we have been able to staff our own classrooms with dedicated teachers who have a missionary zeal and are willing to make the monetary sacrifice. But the question asked by many teachers today is: "Why should I sacrifice money for a college education for my children by going into the teaching profession?"

How would increasing salaries alleviate the teacher shortage? If I can believe some of the things I hear, there are literally thousands of people qualified to teach mathematics and science who are doing fringe engineering jobs, and who would love to be back in the mathematics and science classroom, if they could only make a living at it! (I say back into the classroom, for many **were** former teachers. Many others, though, would be teaching for the first time.) Teachers have been fighting for better salaries for years. Many of us quit the field for a while, but now we are back again battling for education. I am chairman of the salary policies committee of our Teachers Federation, and I am convinced that the parents and public in general must come to our rescue.

I would like to suggest that the Association for Computing Machinery go on record as favoring substantially increased salaries for teachers and that each member do something about it in his own school community. I believe your voices will be heard and heeded. An adequately trained and adequately paid teaching staff **can** turn out the potential scientists we need.

In 1954 some of my senior girls at Connecticut College for Women with an AB degree, with major in mathematics or science, took jobs in the computing field at about $4000 (several dollars more than I was making). Today, three years later, they are at about $6000. I have teachers with master's degrees on my staff making much less than $6000 after more than 12 year's experience! Why should smart mathematics students go into teaching when such low salaries are now being paid to teachers?

You may feel that I have dwelt on salaries too long, but what I have to say in a moment about an adequate curriculum for the high school goes right back to **money** to buy teachers and give them free time to **think** and devise new programs in the light of present day developments. Much of this free time is to be found only during the summer months. Teaching, well done today, is a full-time, year-long job.

It has been suggested by many people that we raise salaries of mathematics and science teachers above the regular salary schedule, say, $1000 or more depending on the salary schedule. I have not supported that sort of thing so far because teachers need **all** salaries raised. Dr. Forsythe has pointed out to me that in order to keep qualified mathematics and science teachers in the classrooms maybe we must have a crash program like this and gradually bring the other teachers' salaries up to it, since to make large jumps in all salaries would make the cost prohibitive.

This argument has merit, but I am still worried about teacher morale. Yet, private schools and colleges do this sort of thing all the time, paying attention to the law of supply and demand and maybe this needs to be examined more carefully as a distinct possibility. But I am also afraid this would be used as an excuse to keep other salaries too low. We need well paid teachers in all fields.

Strong Curriculum Needed

On to my second point of attack: The high school curriculum in relation to scientific personnel and computer needs.

I feel that a strong mathematics and science curriculum in high school is basic to the training of future scientists. I also believe that good high school science courses must be available, too. I don't want to debate which one is more basic, but please let me outline the high school mathematics curriculum that I believe is absolutely necessary if we are to meet the challenge of modern society and the shortage of well-trained personnel in **all** fields — not just science alone. For we need social scientists and people in the humanities that really know and appreciate mathematics and science. As you might suspect, I will be outlining the mathematics program at Newton High School. It consists of four levels:

First level: There must be an advanced track, an advanced placement program for those students who are the top thinkers in mathematics. The program is the one outlined in the Advanced Placement Bulletin of the College Entrance Examination Board. It covers elementary, intermediate, and advanced algebra, plane and solid geometry and elements of analytic geometry; and it is topped off in the senior year by a **first year** college course in differential and integral calculus.

Teachers of the caliber required to teach these students are not available in many schools today because the school committees and school boards will not pay the price to get them. This is not necessarily the school board's fault, because the townspeople may not have convinced the board that they want a first class school system.

Second level: There must be a second track, a sequence of four years of standard college preparatory mathematics. It covers: 9th grade spent on elementary algebra; 10th and 11th grades spent in studying plane and solid geometry, and intermediate algebra; in the 12th grade or senior year, advanced algebra, trigonometry, introduction to analytic geometry, and some calculus of polynomials.

Third level: There must be another track for slower students of mathematics, late bloomers so to speak. It covers: 9th grade, elementary algebra; 10th grade, geometry; 11th grade, intermediate algebra; and in the 12th grade, review of arithmetic, algebra, and geometry, and one-half year of trigonometry. This course is for boys and girls going to technical institutes and also to some of the less demanding colleges.

Fourth level: There must be a general mathematics sequence of three years study for those boys and girls (and there are some) who find or will find that all of the above three tracks are more than they can handle.

To keep a qualified staff of 16 to 18 people to handle this program for a high school of 2000 students costs money and is going to cost **more** money. One needs a master's degree in mathematics to handle the advanced program as outlined above.

This program looks good, but it still isn't good enough for this modern day world. At the invitation of Prof. Max Beberman, project director of the University of Illinois Committee on School Mathematics, Newton is entering their program of Secondary School Mathematics in four classes in two of Newton's five junior high schools. The Project Staff has completely rewritten high school mathematics, putting in as much modern mathematics, as can be made understandable to high school students. Revisions of the text materials are constantly going on in the light of experience gained in teaching the materials.

I think this is one of the most promising developments in secondary school mathematics under way at the present time. The old traditional high school mathematics is not nearly as exciting as this new program. Also it does not get to the so-called modern mathematical concepts that are useful in the computing field nearly so quickly. Here again we need money to pay the salaries of the people who have obtained or will obtain such training in modern mathematics.

Industry Assistance

Now for my third angle of attack: How can industry help in high school science education?

We, in the secondary schools, need some elementary units on computers which we as mathematics teachers can understand and bring in at the proper moment during the various high school mathematics courses.

There are qualified computer personnel that could write these units, if they would take the time to do it. You people could invite a science and a mathematics teacher in your own community to have a look at some of the things going on in your industry and gently get them excited about it. This is a delicate problem I know, but it can be done if you don't make the teacher feel uncomfortable and inferior because he doesn't know about these things. Here is where a summer job with an industry would pay off.

In Newton, our mathematics curriculum is pretty full, but school is out at 2:30; so I am thinking seriously of a seminar at 2:45 sponsored by the Mathematics Club featuring a person from the computing field armed with suitable text materials mimeographed for each member of the seminar, and also any hardware that can be easily transported, and finally a tour of some computer installation. For this program to be successful, I will need at least a key math teacher who is willing to learn something of the computer field. I will expect to be in on the show at first, but it can't be a one-man show over the years.

The proposal that industry supply an engineer to take over mathematics or science classes to alleviate the teacher shortage problem can work very well at the college level, but I have serious doubts about its feasibility at the high school level. For there is much more to teaching in high school than just going in and meeting a class. The administrative details would have to double up on regular teachers' shoulders; then we are in real trouble.

The general feeling that I have found to this proposal has been very negative. I still believe the best way for industry to win the confidence of the teacher and really help him is through summer employment. Part of the expense could surely be written off by the company as expense attributable to public relations and community education.

In talking this problem over with Dr. Navez, head of our Science Department, he suggested that we needed simple computer kits with complete drawings and instructions for building a simple computing machine. Could it be that industry has discarded hardware that could be given to the high school science department, maybe for a small fee?

Schools have been reluctant to set aside money for teachers to attend professional conferences. The problem of substitute teachers and their pay is also part of the picture. Industry could be of great help here by offering to pick up the tab for part of the expenses and furnishing an engineer to substitute for the teacher. This has been done in several areas already. As an example, Arthur D. Little, Inc., Cambridge, Mass., paid my travel expenses to this conference and the Newton Public School system is paying the other expenses.

Questions

I have had my say now and would like to ask some questions. Will someone please outline briefly for me some of the teaching units in the computing field that they think should be taught to high school students? By a teaching unit I mean a body of knowledge, facts, material, etc., that is organized in a unit for teaching purposes.

I have a feeling that we on the high school level have a responsibility for the general education of students about the computing industry. I don't think we can discharge this responsibility effectively unless the computing industry supplies us with the proper materials and teaching units for our own education as well as the students'. I personally am mostly interested in teaching units suitable for mathematics classes, but if you have ideas about science units, I would like to pass them along.

Another question: During August I will be thinking and trying to develop some teaching materials in mathematics that can be used with large groups of 100 or more, using a 12x12 screen, projectors, overhead projectors, overlays, etc. Could a unit lasting one or more 50 minute periods be developed for general education about computers that would be worth the time and effort involved?

My friends know me as an eternal optimist, but my experience during the last two years trying to find qualified teachers to teach mathematics for sub-professional salaries has me deeply concerned about our future supply of well-qualified scientists.

III: INDUSTRY CAN PROVIDE OPPORTUNITIES FOR TEACHERS

DeForest L. Trautman

Communications Systems Department
Hughes Aircraft Co., Culver City, Calif.

(A summary of a talk presented as part of a panel discussion on "The Role of Computers in High School Science Education" at the meeting of the Association for Computing Machinery, Houston, Texas, June 20, 1957.)

THE topic of this panel discussion is indeed provocative! Because of the newness of computer technology, we suspect a paucity of computer material in high school science education. Yet, because of the dearth of time now available for fundamental science education we suspect little desire to further overload the curriculum. From another viewpoint, however, we recognize the impact of this new technology as a tool in science, in business, and as an important part of our scientific culture "to know about." Postulating, then, that computer technology **will** have a role to play in high school education, let us examine **how** it might be played.

To be of inspirational or technical help to the student, the **teacher** must himself have some appreciation and understanding of computers. This means that years after his formal college preparation for science or mathematics teaching the teacher must knuckle down to master the new knowledge of computers. This is but indicative of the practice of life-long learning that high school teachers must engage in merely to keep abreast. The following paragraphs briefly indicate examples of industry-school personnel exchanges as a mechanism for such contemporization, and they dwell more fully on a specific Hughes computer seminar experience with high school teachers.

Personnel Exchanges Between School and Industry

The number of summer jobs in industry for high school teachers of science and mathematics is increasing each year. To serve the needs mentioned earlier, such jobs should really be positions, professional positions in which the teacher has an opportunity to participate in his technical field. One example of this kind of activity is the Arthur D. Little program near Boston, which is akin to certain cooperative work-study programs for college students. Two teachers hold one job in the Arthur D. Little plant in sequence, each teaching one semester of the year.

In Los Angeles industry, chiefly aeronautical and electronic research and development, about 100 professional positions in some 15 companies are available this summer for teachers to engage in their technical specialty. At Hughes, 19 teachers, nine back for the second summer, will be assigned to professional positions in research and development. Examples of technical areas are ferrite physics, gaseous electron tubes, digital computers, analog computation, network theory. Competencies embrace mathematics, physics and chemistry. The teachers are paid at their school system rate and are hired for the summer only; additionally they receive salary points toward upgrading from their school system. The teachers, their supervisors and both school system and Hughes officials attest to the value of the experience, and the practice is spreading to other companies and school districts in the Los Angeles area.

Other personnel exchanges include summer work in industry for students and visiting lecturers from industry in the school classroom. A high school student team successfully tackled a Washington, D. C., civil defense problem last summer at the Operations Research Office of John Hopkins University; and the project will be repeated this summer. Hughes has initiated a similar student project this summer, selecting in cooperation with several adjoining school districts a dozen outstanding students having at least one semester of high school remaining. One anticipated outcome is the catalytic effect of the enthusiasm of the students returning to their schools and classmates in the fall.

Scientists and engineers from industry have been called on for some time and in many locales to speak to science clubs, assemblies, career days, and Parent Teacher Association meetings; they have given guest lectures on technical topics in the classroom. A program having considerable educational depth has now been conducted by Hughes for a calendar year. It consists of an organized team of four or five Hughes technical personnel to give a series of contemporary lecture-demonstrations stemming from the professional experiences of the panel and integrated with the course text and syllabus. This last year some 22 technical staff members comprised five lecture teams in Physics I and II, Chemistry I and II and mathematics, participating in four high schools.

The very favorable results justify continuation of this program and its expansion to other companies and schools. Needless-to-say some of the application material of these lecture-demonstrations can include computer technology — although such is not the sole prime objective.

Experience with a Computer Seminar for Teachers

During summer 1956, the 10 teachers in the Hughes program devoted about 20 percent of their time to orientation lectures and to get-togethers of their own group to relate their work experiences to their subsequent teaching activities. Near the close of the summer, it was decided to reassemble the group occasionally throughout the fall to provide follow-through into the classes. This follow-through took the form of a series of five 8-hour Saturdays, September to December, and was a seminar or workshop devoted to "arithmetic computers." This topic resulted from interest in an earlier orientation talk on computers and from the fact that seven of the teachers were in mathematics.

Of interest at this point is the concentration on digital rather than analog computers because of the dearth of appreciation of calculus! Brief background talks and demonstrations were given on the REAC, mechanical Differential Analyzer, and EASE, while more serious attention was given to IBM computers, the SWAC computer, and a successor to the "Geniac" computer kit.

Considerable time was spent on coding a problem for the SWAC and then on running through the solution so that the teachers would be forced to think hard about the meaning of arithmetic operations — all in trying to understand what the machine would do. The modified "Geniac" was a plugboard with toggles and multiple-deck, multiple-position switches (and lights), such that a number of the classical logic games could be implemented. Of great interest to the teachers was the methodology for expressing symbolically the logic of a situation, such as the automobile turning indicator, the translation of this into a diagram, and finally implementation by simple circuitry.

Assimilating this new knowledge was rough for the teachers but they "sweat it out" and, in addition, produced an excellent manuscript for the benefit of their fellow teachers. Under title of "An Introduction to Arithmetic Computers", it contained the following chapters, amply illustrated by examples: Number Systems, Arithmetic Operations, Mechanical and Electrical

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WHO'S WHO

in the COMPUTER FIELD, 1956-57

1. Some Statistics 2. Supplement of New or Revised Full Entries

1. Some Statistics About Computer People

WHAT are computer people like as a group? After publishing "Who's Who in the Computer Field, 1956-57"* in March, we became curious about the characteristics of computer people, and we decided to make use of the Who's Who to see if we could find out some things about them.

In the Who's Who, the entries covered 199 pages of about 61 entries each, or about 12,100 entries. About 4130 of these entries were full entries containing name, title, organization, address, main interests, year of birth, college or last school, year of entry into the computer field, occupation, distinctions, publications, etc. The remaining entries were brief entries containing only name and address (sometimes also organization).

We decided to construct a 10 percent sample by going through all the full entries, selecting every 10th name in alphabetic order, and tabulating that entry. If such a sample fairly represents computer people, then we can answer such questions as the following at least:

1) What kinds of organizations do computer people work in?

2) How many are interested in one or more of construction, design, and electronics?

3) How many are women?

4) How old are computer people?

Here Are the Answers

The answers to these four questions appear in the four tables which appear below.

It is interesting to note that the six largest employment fields for computer people (outside of manufacturers of computers or computer components) are: The U. S. government, the aviation industry, university research and teaching, management consultants, insurance, and utilities.

Table 1: THE ORGANIZATIONS WHERE COMPUTER PEOPLE WORK

1. Makers and Suppliers of Computers, Data Processing Machines, and Services:	45.4%
Computer Manufacturers	14.5
Business Machine Manufacturers	1.0
Component Manufacturers	13.5
Computer Centers and Services	12.6
Management Consultants	3.8
2. Other Industries:	33.7%
Automobile Manufacturers	1.6
Atomic Development	1.6
Aviation	6.2
Banks	0.5
Chemicals	1.2
Electrical and Electronic Manufacturers	8.9
Insurance	3.6
Machinery, heavy	1.0
Oil	1.9
Railroads	1.2
Utilities	3.6
Various other industries	2.4
3. Other:	20.9%
U. S. Military Forces	9.5
U. S. Government	2.6
University Research and Teaching	5.5
Miscellaneous	3.3
Total	100.0%

Table 2: INTERESTS IN CONSTRUCTION, DESIGN, AND/OR ELECTRONICS

In a full Who's Who entry, provision is made for checking one or more of C, D, and E for denoting as a main interest construction, design, and/or electronics respectively. The statistics for the sample show:

C	2
D	42
E	33
C, D	14
C, E	1
D, E	59
C, D, E	41
Total C, D, and/or E	192
Other	221
Total reporting	413

and this leads to:

Computer people interested in construction, design, and/or electronics	46.5%
Other computer people	53.5
Total	100.0%

This indicates that slightly less than half of the people in the computer field are interested in construction, design, and/or electronics.

*Who's Who in the Computer Field, 1956-57, published March 1957, by Computers and Automation, 815 Washington St., Newtonville 60, Mass., photo-offset, 212 pages, $17.50. Also see the Who's Who entry form on page 27.

Table 3: WOMEN AMONG COMPUTER PEOPLE

Women	5.3%
Men	94.7%
	100.0%

There are many reasons for believing that the proportion of women in the computer field should grow steadily. Many good jobs for women exist in the computer field, especially in programming, coding, mathematics, logic, and system analysis.

Table 4: THE AGE OF COMPUTER PEOPLE

Age Group	Percent
22 and under	0.3
23 to 27	8.1
28 to 32	31.8
33 to 37	30.5
38 to 42	13.9
43 to 47	7.8
48 to 52	4.5
53 to 57	1.8
58 to 62	0.8
63 and over	0.5
Total	100.0%

It is striking to note that apparently over 90 percent of computer people are under age 48. A little evidence of bias in the sample shows in this table. There must be more computer people age 22 and under than 0.3%; but apparently they are so modest that they rarely send in full entries for the Who's Who.

2. Supplement No. 1 of New or Revised Full Entries

There are two kinds of entries for persons in the Who's Who in the computer field: full entries and brief entries. The full entry consists of: name/ title, organization, address/ interests (the capital letter abbreviations are the initial letters of the interests Applications, Business, Construction, Design, Electronics, Logic, Mathematics, Programming, Sales)/ year of birth, college or last school (background), year of entering the computer field, occupation/ other information, such as distinctions, publications, etc. / code. In the code, the digit such as 5 or 6 denotes the year '55 or '56, when the information in the entry was received or revised. In cases where no information was given, a "–" denotes omission. The brief entry consists of: name/ address – or else: name/ organization/ address. Nearly all the abbreviations may be easily guessed like those in a telephone book. For translations of some of the abbreviations, see page 14 of the Third Cumulative Edition.

New, Revised Listings

Following are a number of new or revised full entries for the "Who's Who in the Computer Field, 1956-57", constituting Supplement No. 1 to the Third Cumulative Edition.

A

Anderson, Paul E / Engr, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / A / '20, West Point, '50, engr / manual on prodn contr & its automatn, artls on automatn / 7

Antonini, Frank P / Compr Field Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / ACDELMP / '29, Univ of Santa Clara, '56, elecnc engr / 7

Armstrong, Lancelot W / Data Procg Expert, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / A / '16, Syracuse Univ, '49, – / 7

B

Barclay-de-Tolly, George E / Logicl Desn Engr, Gen Elec Co, Bldg 312b Stanford Res, Menlo Park, Calif / ELMP / '27, Ohio State Univ, Univ of Toronto, '56, engr / 6

Bekey, George A / Mgr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / ALMP / '28, Univ of Calif at L A, '51, engr / four publ papers on compr aplns / 7

Beyer, Harold / Supply Specialist, U S Army Signal Supply Agency, 225 So 18th St, Phila 3, Pa / AP, supply mgm / '21, CCNY, '54, supply specialist / attended IBM 705 prgmg course / 7

Billinghurst, Edward M / Devt Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / AD / '22, Univ of Calif at Berkeley, '56, elecncs engr / 7

Binder, Sidney / Survey Statn, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / A / '12, CCNY, '34, statn / consltnt tab methods / 7

Bruck, Donald B / Res Asst, MIT, Dynamic Analysis & Controls Lab, Cambridge 39, Mass / ADELMP / '35, MIT, '56, engr / 7r

Burgess, R E / Royal McBee Corp, 32 Green St, Newark, N J

C

Codd, Edgar F / Sr Plng Repr, IBM Corp, Res Lab, Poughkeepsie, N Y / ABDLMP / '23, Oxford, Eng, '49, mathn / 7t

Crowley, William V / Western Regional Sales Mgr, Alwac Corp, 13040 S Cerise, Hawthorne, Calif / APBS / '19, Stanford Univ (MBA), '53, compr sales / publn, formerly in charge all elecnc data procg at Aviation Supply Office / 7

D

De Biase, Ramon N / Elecncs Coordinator, N Y Life Ins Co, 51 Madison Ave, NYC / ABP / '28, Columbia Univ, '53, IBM methods cordntr / mbr Natl Machine Acctnts Assoc / 7

E

Ender, Robert C / Apln Engr, Gen Elec Co, Schenectady 5, N Y / ABLMP / '28, Union Coll, Univ Maryland, '52, elec engr / 7

England, Samuel J M / Principal Economist, Battelle Memorial Inst, 505 King Ave, Columbus, Ohio / DCAEMP, philosophy of autmn / '27, Univ of Texas, '55, engr / 7

F

Farrington, C C, Jr / –, Univ of Ill, Urbana, Ill / AM / –, –, –, – / paper ACM mtg '56 / 6

Finnell, C D / Compr Sales Mgr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / AS / '23, Colorado A & M, '50, engr / 7

Flannell, C Fred / Dir, Scientific Compr Dept, Royal McBee Corp, Westchester Ave, Port Chester, N Y / AS / '28, So Illinois Univ, '52, director / 7t

Fowler, James L / Compr Field Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / ADS / '29, Fresno State Coll, Fresno, Calif, '55, engr / 7

G

Garofalos, John / Jr Prgmr, Sperry-Rand Corp, 2601 Wilshire Blvd, L A 46, Calif / ABS / '29, Univ of Penna, '55, custmr supprt – Univac / 7t

Glaser, Ezra / Economist, Statn, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / AM / '13, Columbia Univ, '47, ecomist, statn / Pres, Wash Stat Soc, mbr ACM, ASA, Inst for Mgm Sciences, artcls mathl economics, prgmg, stat orgnztn / 7

Gordon, Bernard M / President, Epsco, Inc, 588 Commonwealth Ave, Boston, Mass / ADE / '27, MIT, '48, exec / num papers & artls, authr series "Adapting Dig Techs for Automtc Controls" / 7

H

Harris, Mark / Devt Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / ADEM / '24, Cornell, Univ of Calif, '55, engr / 7

Hawes, Mrs Mary K / Prgmr, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / AP / '10, Univ of Okla, Chattanooga, '51, prgmr / papers, ACM, Automatic Control Mag / 7

Hershovitz, William P / Sys Analyst, USASSA, Stock Mgm Div, 225 S 18th St, Phila 3, Pa / AP, supply mgm / '25, Temple Univ, '56, supply speclst / 7

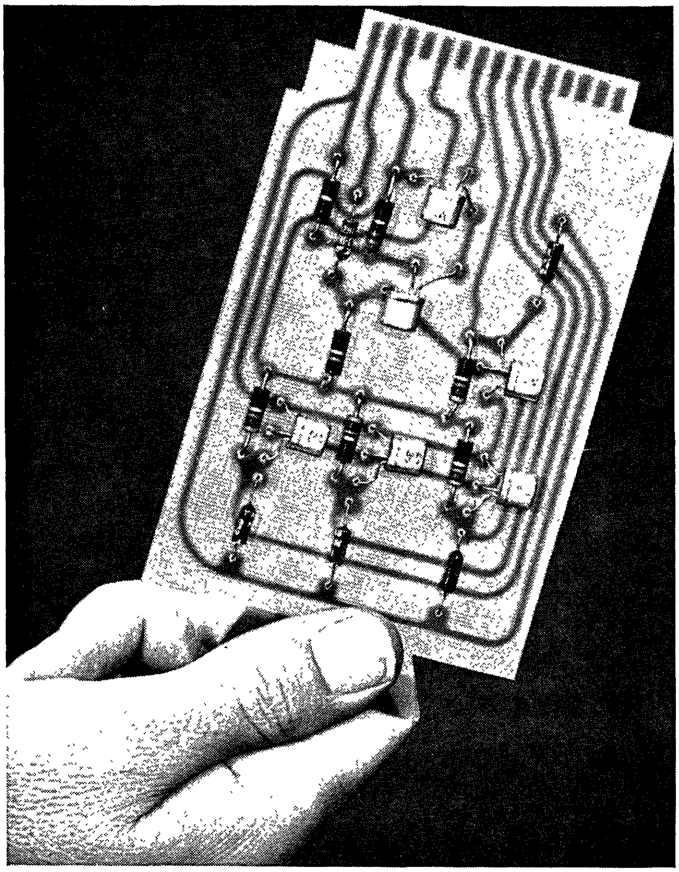
Hussey, J L / Mgr, Comprs, 2200 Wright Ave, Richmond 3, Calif / ABCDELMPS / '28, Univ of Calif at L A, '50, elecnc engr / 7

K

Kimber, Robert L / Elecnc Sys Analyst, Gen Tire & Rubber Co, 1708 Englewood Ave, Akron 9, Ohio / AMP / '26, —, '56, prgmr, sys analyst / 12 yrs tablg / 7

King, Arnold J / President, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / A / '06, Iowa State Coll, Univ Wyoming, –, mathl stat / V Pres Amer Stat Assoc, mbr regnl advisory bd of Biometrics Soc, advisory comm & consumrs expendtr tabs comm Amer Mrktg Assoc, authr techl artcls mathl stats / 7

Kircher, Paul / Assoc Professor, Schl of Bus, UCLA, LA 24, Calif / B / –, Univ of Mich, –, professor / 6



L

Liebert, George E / Supply Specialist, USASSA, Stock Mgm Div, 225 So 18th St, Phila 3, Pa / AP, supply mgm / '22, Northeast High, '55, sys analyst / 7

Lister, Mary / Assist Prof Math, Penn State Univ, Univ Park, Pa / ABMP / '27, Univ of London (Eng), '53, assist prof / 7

Longo, Len / Deptl Assist, No Amer Aviation, 4300 E Fifth Ave, Columbus, Ohio / BP / '26, Ohio State, '57, deptl assist / 7

Ludwig, Robert C / Acct Rep, Rem Rand Univac, 2601 Wilshire Blvd, L A 54, Calif / ABS / '14, Oregon State Univ, '42, sales rep / methods, sys, sales engr / 7

M

MacLane, Alan B / Chief Field Engr, Compr Dept, Beckman, Berkeley Div, 220 Wright Ave, Richmond 3, Calif / CDES / '25, Univ of Calif, '54, elec engr / 7

Marks, Eli S / Mathl Stat, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / APM / '11, Columbia, –, statn / Phi Beta Kappa, fellow ASA, artls & books in Psychology & stats / 7

Miller, David R / Mgr, Richmond Compn Ctr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / ALMP / '26, Denver Univ, '52, mathn / 7

N

Neumiller, Joseph L / Supv, Data Procg, Folger Coffee Co, 101 Howard St, San Francisco, Calif / B / '21, Univ of Calif, '52, supv / mgr Elecnc Bus Sys Conf, '56, natl dir NMAA / 7

O

O'Donnell, Mrs Jane M / Psychologist, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / A / '15, Swarthmore Coll, Univ of Berlin, '54, psychologist / 7

Orr, Dell J / Methods Analyst, Gen Tire & Rubber Co, 1708 Englewood Ave, Akron 9, Ohio / ABP / '21, Akron Univ, '56, EDP methods analyst / 7

P

Paxson, Beverly L / Engr, Richmond Compn Ctr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / AMP / '26, Univ of Calif at Berkeley, '54, anal compr prgmr / 7

Pepper, James H / Devt Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / D / '22, Univ of Calif at Berkeley, '55, engr / 7

Phillips, Kenneth / Prgmr/ Instr, Rem Rand Corp, 315 4th Ave, NYC / ABPS / '31, CCNY, '55, prgmr / 7r

R

Rittler, C Alvin / Prgmr, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / AP / '27, Chas Morris Price Schl of Advertsg & Journlsm, –, prgmr / 7

S

Schmidt, R C / Sr Devt Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / CD / '27, Whittier Coll, '51, desn engr / 7

Schwartzbart, Milton / Data Procg sys analyst, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / A / '15, –, '54, sys analyst / 7

Schweber, Seymour C / Mgr, Schweber Elecncs, 122 Herricks, Mineola, L I, N Y / BES / '15, Brooklyn Coll, –, exec / 7t

Single, Charles H / Chief Proj Engr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / D / '26, Mich State Univ, '50, engrg admin / papers at ACM, ASME, ISA / 7

Slimak, Romuald / Chief Statn, Rem Rand Univac, 315 4th Ave, NYC 10 / AMP, stats, teaching / '26, Univ of London, '54, statn / Adj Asst Prof Math, NYU, mbr hi speed compr com Inst Mathl Stats / 7

Small, Harold E / Engr, Philco Corp, 4700 Wissahickon Ave, Phila 44, Pa / DE / '21, –, '52, engr / 7

[Please turn to page 30]

BOOKS and OTHER PUBLICATIONS

(List published in "Computers and Automation", Vol. 6, No. 8, August, 1957)

WE publish here citations and brief reviews of books, articles, papers, and other publications which have a significant relation to computers, data processing, and automation, and which have come to our attention. We shall be glad to report other information in future lists if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / comments. If you write to a publisher or issuer, we would appreciate your mentioning **Computers and Automation.** In the case of a review with a by-line, the opinions expressed are those of the reviewer and not necessarily the views of **Computers and Automation.**

The following reviews are by Ned Chapin, Menlo Park, Calif.

Rubinoff, Morris, and Ralph H. Beter/"Input and Output Equipment" pp. 115-123 in Control Engineering, Vol. 3, No. 11, Nov. 1956/McGraw-Hill Publishing Co. Inc., 330 W. 42 St., New York 36, N. Y./1956, printed, $4.00 per year.

The authors classify input and output equipment for automatic computers in terms of the use made of the computer. Delayed-time use, real-time use, and computer-control-and-maintenance use are the three computer-use situations contemplated. In delayed-time use, equipment capable of handling alphameric symbols is most widely used. Two examples are punched card equipment and line printers.

In real-time use, high speed is necessary and communication must be established between the thing controlled and the automatic computer. Analog-to-digital converters, digital-to-analog converters, control devices, and visual displays, such as on CRT's, are common. The input and output equipment used with automatic computers in real-time uses broadly overlaps those used in delayed-time uses.

In control and maintenance by means of automatic computer, the input and output equipment is subject to qualitatively and quantitatively different requirements than in either real-time or delayed-time uses. Terse, rapid, "high entropy" communication devices are needed. The authors feel that present input and output equipment in this area of use lags further behind needs than it lags in the other two areas.

The authors devote much of the article to a discussion of the logical design of magnetic tape-handling equipment.

* * *

Berkeley, Edmund C., and Lawrence Wainwright/"Computers: Their Operation and Applications," 366 pp./Reinhold Publishing Corp., New York, N. Y./1956, printed, $8.00.

The contents of this readable book lists rather well what the book covers. The book is divided into seven sections whose titles are: 1 — Machines that Handle Information; 2 — Automatic Digital Computer Machines; 3 — Automatic Analog Computing Machines; 4 — Other Types of Automatic Computing Machines; 5 — Miniature Computers and Their Use in Training; 6 — Some Large Scale Digital Computers; and 7 — Applications of Automatic Computing Machines.

The first two sections consisting of 74 pages are introductory in nature and introduce the basic vocabulary of the field. Included in these sections are some reprints of reference material from "Computers and Automation."

Section three of the book is primarily the work of Lawrence Wainwright. This section introduces analog computers by means of mechanical analogies. This section is 85 pages long and contains a number of illustrations and diagrams.

Section four is very brief and consists of only eight pages which are primarily devoted to listings of equipment, type, and components.

Section five (40 pages in length) dealing with miniature computers is primarily devoted to "Simon."

Section six on Large Scale Digital Computers discusses in some detail the following machines: the UNIVAC I and II; IBM 701, 702, 704, 705; and ERA 1103 (UNIVAC Scientific). On page 216, the author describes the speed of UNIVAC I in terms of "the average number of three-address operations." This gives the impression that the UNIVAC is a three-address machine, which it is not. The UNIVAC is a one-address machine with two instructions per word. To be consistent, the author should have quoted the speeds for the other machines in comparable terms but he did not.

It is also noteworthy that over half of the discussion of this section six is devoted to UNIVAC I and II and that the other machines combined are relegated to less than 50 percent of the space. The discussion on each point of the other machines is much less thorough and complete than in the case of UNIVAC I and II.

Section seven, devoted to applications, covers 58 pages. This section which is the work of both Berkeley and Wainwright discusses briefly the following topics: "Whose work can automatic computers do? what people may buy automatic computers? the attitudes of prospective buyers toward automatic computing machines; applications of automatic computing machines in business; military applications of analog computers; applications of automatic computing machines to other fields; recognizing areas for automatic computing machine applications."

From page 305 to the end of the book, will be found reference information such as a list of organizations in the automatic computer and automatic instruments field, lists of publications, lists of books, a good glossary reprinted from **Computers and Automation,** and an index to the book.

* * *

The following review is by Edith Taunton, Weston, Mass.

Karlqvist, Olle, and Gunnar Hellstrom / Ordlista Inom Omradet Datamaskiner Och Berakningsmasker (Glossary of Terms for Data Processing Machines and Calculating Machines) / Aktiebolaget Atvidabergs Industrier (Atvidabergs Industries Co.), Elektronikavdelningen (Electronic Divisions), Stockholm, Sweden / 1956, photo-offset, 24 pp, limited distribution.

This is a glossary of electronic terms published by the Electronics Department of the Atvidabergs Industries in Stockholm. All definitions of terms are in Swedish, but both the German and English translations of the terms themselves are provided.

The glossary is good; it indicates the progress in interest and use of electronics in Sweden — the interest certainly appears similar to our own in this country, and fully as advanced.

The introduction states the names of members of Atvidabergs Industries and coworkers in other companies such as Svenska Aeroplan who have helped compile the glossary; it also gives credit for certain definitions, etc., to the January and October, 1956, issues of **Computers and Automation** and the September, 1956, Proceedings of the IRE. Pages 23 and 24 contain a translation of English digital computer terms into their Swedish equivalents, arranged in the alphabetic order of the English terms.

The Editor's Notes and Readers' Forum

[Continued from page 9]

precision, depending on the precision of the original factors.

This type of command exhibits complete flexibility in the variable length of multiplication time as dictated by the precision of the factors involved and specified by the programmer.

INDUSTRY NEWS NOTES

Ed Burnett

New York, N. Y.

RAMO-WOOLDRIDGE CORP., Los Angeles, Calif., has announced development of a new, compact advanced digital control computer to provide fully automatic control for industrial process plants. The new computer, known as the RW-300, can automatically read process instruments, perform the computations necessary to relate these readings to process objectives, determine control actions that will result in best plant operation, and actuate process mechanisms or adjust set points on supervised control loops.

PHOTRONIX, Columbus, Ohio, is a new organization formed to apply electronic computing methods in the interpretation of aerial photographs for engineering purposes. The processes used reportedly save up to 60 percent of the time required to produce highway plans, and eliminate sub-professional drudgery by integrating the sciences of aerial survey, photogrammetry, and electronic computing.

ELECTRO-DATA division of Burroughs Corporation, Pasadena, Calif., in cooperation with the atomic energy division of AMERICAN-STANDARD CORP., is presenting a new mathematical approach to the design of nuclear reactors. Known as DMM (Diffusion Multigroup Multiregion), this complex code involves the utilization of a computer to predict the point at which a reactor will generate enough controlled power to sustain itself. By utilizing the 40,800 digit capacity of the computer's memory drum, DMM is reportedly able to permit prediction of operation at various energy levels involving elastic and inelastic scattering of atomic forces in planar, cylindrical, and spherical reactors. Among the organizations using the DMM code are the Nuclear Development Corp., American Machine & Foundry Co., and Babcock & Wilcox.

METROPOLITAN-VICKERS ELECTRICAL, Ltd., London, England, has developed a computer system to test strains undergone by aircraft components under high temperature created by extremely high speeds. The computer equipment provides a coordinated system for carrying out simulated tests while retaining the flexibility required to meet varying requirements of different users.

PACKARD-BELL ELECTRONICS CORP., Los Angeles, Calif., has received a research and development contract from the Army for a high speed digital computer. The new equipment, when completed, is to be installed at the U. S. Army Computation Center, Redstone Arsenal, Huntsville, Ala.

GOODYEAR AIRCRAFT CORP., Akron, Ohio, has added a new analog computer, the GEDA A-14, which is expected to have far-reaching applications, ranging from small problems to very large problems requiring hundreds of d-c computing amplifiers and any number of nonlinear elements. This new computer automatically checks the problem setup and the operation of each computing element through a built-in program analyzer, and records the result on a read-out printer. Goodyear believes the concentration of parts and wiring in the patchbay area of analog computers generally results in poor accessibility. In the A-14, the resistor cards plug into the back of the patchbay board, with connections to the cards being made by taper pins. This eliminates soldering, and makes possible easy replacement.

RECORDAK, New York, N. Y., a subsidiary of EASTMAN KODAK, has opened a new product planning department to investigate and develop new, improved applications of microfilming including electronics automation. Studies will include a wide field of applications where microfilming is used in electronic storage and retrieval of business and government information.

CLARY CORP., San Gabriel, Calif., now produces a self-contained scanning digital printer. The machine converts a parallel set of decimal contact closures into a printed digital record. Maximum printing capacity is 12 digits per line, with a minimum printing rate of three lines per second.

INTERNATIONAL BUSINESS MACHINES CORP., New York, N. Y., has announced two new optional features — file search, and additional magnetic core storage — to increase the capacity and flexibility of the IBM 774 Tape Data Selector. The 774 serves as a basic translator between magnetic tape units and card-operated machines by providing a punched-card "image" of data recorded on the tape. With the new file search feature, users of the 774 can rapidly locate any individual record or class of records within a file of magnetic tapes, at a speed of 15,000 characters per second. The expanded magnetic core storage permits up to 33% more capacity than previously available.

The same company has installed what is said to be first tape-operated computer (an IBM Tape 650) in the investment and banking field, at Hornblower & Weeks in New York. Most of the 500 IBM 650 computers installed throughout the world have been punch-card operated. Only a few IBM Tape 650's are in use. One reel of tape replaces 27,000 punch cards. The new machine reduces the time to turn out monthly statements from 60 hours to 16.

UNION SWITCH AND SIGNAL, division of Westinghouse Air Brake Co., Swissvale, Pa., has reported a new and unusual application for its new tiny electromechanical, D.C.-operated, storage and readout digital

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Who's Who Entry Form For Computer People

If you are interested in the computer field or some part of it, and if your entry in "Who's Who in the Computer Field, 1956-57", which we published in March, is inaccurate or incomplete or missing, please fill in and send us the following Who's Who entry (to avoid tearing the magazine, it may be copied on any piece of paper). If you wish, you can send it to us postage free by using the business reply label printed next to the Reader's Inquiry Form.

The form to be filled in for a Who's Who entry follows (may be copied on any piece of paper):

Name? (please print) ________________

____

Your Address? ______________________

____

Your Organization? __________________

____

Its Address? ________________________

____

Your Title? _________________________

Your Main Computer Interests?

( ) Applications	( ) Mathematics
( ) Business	( ) Programming
( ) Construction	( ) Sales
( ) Design	( ) Other (specify):
( ) Electronics	________________
( ) Logic	________________

Year of birth? ______________________

College or last school? _______________

Year entered the computer field? ________

Occupation? _________________________

Anything else: publications, distinctions, etc.. ____________________________

____

____

When you have filled in this entry form to the extent that you conveniently can, please send it to: Who's Who Editor, COMPUTERS AND AUTOMATION, 815 Washington St., Newtonville 60, Mass.

Bulk Subscriptions

These rates apply to prepaid subscriptions to "Computers and Automation" coming in together direct to the publisher. For example, if 7 subscriptions come in together, the saving on each one-year subscription will be 24 percent, and on each two-year subscription will be 31 percent. The bulk subscription rates, and savings to subscribers depending on the number of simultaneous subscriptions received, follow:

BULK SUBSCRIPTION RATES
(United States)

Number of Simultaneous Subscriptions	Rate for Each Subscription, and Resulting Saving: One Year	Two Years
7 or more	$4.20, 24%	$7.25, 31%
4 to 6	4.60, 16	8.00, 24
3	5.00, 9	8.80, 16
2	5.25, 5	9.55, 9

For Canada, add 50 cents for each year; outside of the United States and Canada, add $1.00 for each year.

Industry News Notes

[Continued from page 26]

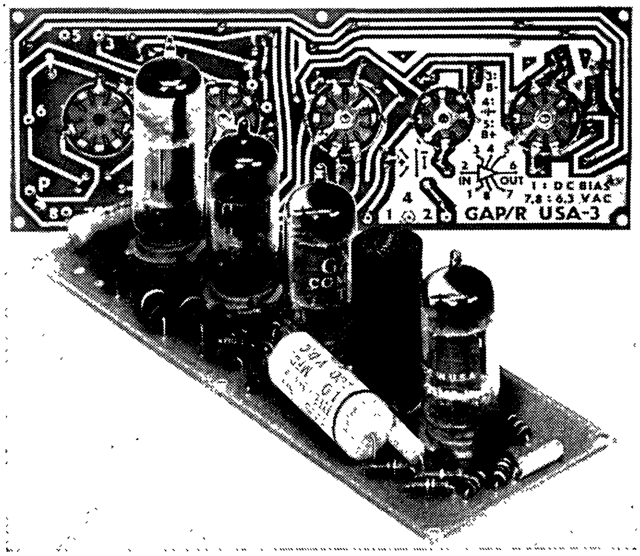
indicators. On CBS-TV's program, "Game of the Week," a Saturday afternoon weekly televised baseball game, three of these miniature indicators are used to show the "up-to-the-minute" batting average of the player concerned. This figure along with the batter's name is superimposed on the screen as each batter comes to the plate. CBS-TV has also ordered additional units to be used in the projection room to designate to the projection room staff, which camera is "shooting" at any specific time.

POTTER AERONAUTICAL CORP., Union, N. J., has introduced a new digital flow indicator and totalizer which can be adjusted to give a direct reading in gallons or pounds per minute, as well as direct readings of speed in revolutions per unit time. Used with two meters made by Potter, the new instrument will indicate the ratio between two flows. The indicator is suitable for many types of flow rate measurement, and can be used as a short-time totalizer, by means of four-digit readout in ¾-inch-high figures on Burroughs Corp., Nixie tubes.

BENSON-LEHNER CORP., West Los Angeles Calif., has announced OSCAR Model N-2. This is a reading machine with a 20″ by 20″ reading area to analyze data recorded as images or traces on film or paper. Automatic read-out of positions to various output units is instituted by pressing a switch. Any one of several standard projection systems may be incorporated where original data is less than 89 mm in width. Output sequence control includes digits, sign position, typewriter control signals such as tab or return, fixed digits, repetitive subroutines, and generation of special codes for later use as computer instructions. The accuracy of the device is stated to be 1 part in 5000. About 50 points per minute maximum can be read, if the machine operator is skilled.

The same company's new ELECTRO PLOTTER Model S provides additional dimensions to the straightforward two-dimensional graphic displays of conventional automatic plotting equipment. The new equipment can be used significantly in fields requiring multi-dimensional plotting such as magnetic and gravimetric mapping, topographical surveying, stress mapping in structures, geophysical sub-section mapping, trajectory flight tracing of ballistic and powered missiles, tabulation of data for production control, automatic drafting and lofting, and the plotting of aerodynamics pressures and stresses on solid sections. The equipment is particularly useful when plots are made at randomly-spaced positions; it is able to display simultaneously basic values, elevation corrections, and second derivatives, which can then be contoured by hand.

AMERICAN ELECTRONICS, INC., Los Angeles, Calif., has introduced a new multi-channel magnetic tape recording system that has a 300 kilocycle band width, accommodates reels up to 14 inches in diameter, and can record 16 channels.



GEORGE A. PHILBRICK RESEARCHES, INC., Boston, Mass., has introduced a new "Universal Stabilized Amplifier" with printed circuit construction. It is an operational amplifier useful in assembling electronic analog computer circuits. (See picture above.)

BJ ELECTRONICS, division of Borg-Warner, Santa Ana, Calif., is marketing a series of standard 6″ x 8″ plug-in etched circuit component cards. The cards, designed for use in BJ's digital data system, are expected to save time and effort in developing data processing systems. The circuit card group comprises: flip-flops, inverters, decimal counters, read-write amplifiers, cathode followers, blocking oscillators, diode logic cards, and general purpose blank panels.

SPERRY GYROSCOPE has demonstrated a "true tracking" radar, which presents in essence a continuous picture of objects within range. This new system permits an observer to tell the difference immediately between moving and fixed objects. For the first time in American radar (Decca has had similar units installed in European ships for the past year) only objects in motion, instead of all objects on the scope, show in motion. The new device also permits off-center positioning, to scan a larger area without changing the range scale.

FERRANTI, LTD., London, England, in cooperation with the British Oxygen Co., Ltd., has developed a computer-controlled flame-cutting machine for cutting steel plate. The new machine is said to include fully automatic operation of the profiling process, as well as automatic controls for the blow pipes that cut, the ignition, the nozzle height sensing, and the cutter head rotation.

TEXAS INSTRUMENTS, INC., Dallas, Tex., has announced commercial production of a high power semiconductor in a glass package, a new diffused silicon diode-rectifier, which was designed to meet military specifications. The diode-rectifier is manufactured by a new production technique utilizing molybdenum for

Industry News Notes

[Continued from page 28]

both electrode connections, which has the same temperature coefficient as the hard glass of the almost shatter-proof envelope.

UNITED SHOE MACHINERY CORP., Boston, Mass., is to demonstrate "DYNASERT" machinery for automatic and semi-automatic assembly of various components in printed wiring panels at the August 1957 WESCON show in San Francisco. Machines similar to those being used in fully automatic installations to produce electronic equipment will be exhibited.

AUTOMATION ENGINEERING LABORATORIES, Greenwich, Conn., has produced a fully automated flexible candy making machine which utilizes a stored memory to control the production, decoration, and packaging of molded chocolate products. The same machine can turn out Thanksgiving turkeys or Easter rabbits, depending on the instructions it receives from the memory-control device.

MINNESOTA MINING & MFG. CO. is opening a large magnetic tape factory (78,000 square feet) on a 24-hour-a-day production schedule. The factory has been designed to achieve almost perfectly clean conditions for production of magnetic tapes for electronic computers, instrumentation recording, and video tape recording.

R. P. MALLORY & CO., Indianapolis, Ind., is to merge with RADIO MATERIALS CORP. of Chicago, effective sometime before October 1. The merger adds ceramic capacitors to the long line of electronic, electrochemical, and metallurgical products manufactured by Mallory.

INDUSTRIAL CONTROL Co., Lindenhurst, L. I., has announced a packaged, servo-driven digitizer, designed to digitize an A.C. input signal. The package, for inclusion in larger equipment, includes a miniaturized high-gain transistor-magnetic servo amplifier and power supply. Typical applications include ground and flight instrumentation, digital conversion for automatic printout, analog translation to feed a digital computer, industrial data logging, and as an input to an IBM card system, or tape.

ESC CORPORATION, Palisades Park, N. J., has announced Model 503, a continuously variable delay line, designed expressly for use as a component or as test equipment in advanced computer and radar systems. The entire delay range, from zero to maximum, is covered by a single control shaft in 10 turns. The unit may be locked at the desired delay.

LOCKHEED MISSILE SYSTEMS, Sunnyvale, Calif., has begun construction on a fourth 51,000 square foot laboratory for research and development, bringing total lab facilities there to 218,000 square feet.

GENERAL ELECTRIC has installed a new automatic processing and computation center for its missile and ordnance systems department. Installation includes an exceedingly fast vibration wave analyzer, as well as an automatic analog switching system used to control switching of all analog data signals from the telemetering translators to the analog recorders.

LORAL ELECTRONICS, Bronx, N. Y., is building a new 100,000 square foot plant for production of electronic gear including plotters, navigational computers, and short range ground position indicators.

Airline Automation

[Continued from page 14]

and automatically fed onto the teletype lines with suitable on, off and sequence codes added.

This machine, as you see, provides the third link in the chain. I think we will see gradual improvement in components but little change in the basic system until we are able to eliminate the card record as we know it today.

The Reserwriter, our name for the Data Organizing Translator, serves an important function and I am sure you will hear more of it in the future. I firmly believe that the Reservisor and Reserwriter portend a whole new group of on-line equipment which will be widely applicable to many businesses.

Who's Who

[Continued from page 22]

Sterne, Karl E / Aplns Engr, Compr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / AS / '27, MIT, '56, engr / 7

T

Tepping, Benjamin J / Mathl Statn, Natl Analysts, Inc, 1015 Chestnut St, Phila 7, Pa / AMP / '13, Ohio State Univ, —, mathl statn / Phi Beta Kappa, Sigma Xi, Merit Serv Award of US Dept Commerce, US Civil Serv Com of Expert Examiners, Stat, artls Jour of ASA, Amer Sociological Rev, books / 7

Thomas, Lt Edward E / Sys Analyst, Prgmr, Defnr, USA Sig Supply Agncy, EDPM Br, 225 So 18th St, Phila 3, Pa / AP, supply mgm / '33, Gettysburg Coll, '56, army officer / attended IBM 650, 705 schl / 7

Turke, James K / Aplns Engr, Compr, Beckman, Berkeley Div, 2200 Wright Ave, Richmond 3, Calif / AS / '27, Univ of Minn, '56, engr / 7

W

Williams, Ronald E / Mgr, elecnc data procg, Gen Tire & Rubber Co, 1708 Englewood Ave, Akron 9, Ohio / ABLMP / '26, Univ of Chicago, '51, economist / 7

Z

Zuse, Konrad / D Sc h c, Diplom-Ingnr, Hd, Zuse Kommandit-Gesellschaft, Neukirchen, Kreis Huenfeld, Ger Fed Rep / ABCDELMPS / '10, Technische Hochschule Berlin, '36, exec / 7

MANUSCRIPTS

WE ARE interested in articles, papers, reference information, and discussion relating to computers and automation. To be considered for any particular issue, the manuscript should be in our hands by the first of the preceding month.

ARTICLES: We desire to publish articles that are factual, useful, understandable, and interesting to many kinds of people engaged in one part or another of the field of computers and automation. In this audience are many people who have expert knowledge of some part of the field, but who are laymen in other parts of it.

Consequently, a writer should seek to explain his subject, and show its context and significance. He should define unfamiliar terms, or use them in a way that makes their meaning unmistakable. He should identify unfamiliar persons with a few words. He should use examples, details, comparisons, analogies, etc., whenever they may help readers to understand a difficult point. He should give data supporting his argument and evidence for his assertions.

We look particularly for articles that explore ideas in the field of computers and automation, and their applications and implications. An article may certainly be controversial if the subject is discussed reasonably. Ordinarily, the length should be 1000 to 3000 words. A suggestion for an article should be submitted to us before too much work is done.

TECHNICAL PAPERS: Many of the foregoing requirements for articles do not necessarily apply to technical papers. Undefined technical terms, unfamiliar assumptions, mathematics, circuit diagrams, etc., may be entirely appropriate. Topics interesting probably to only a few people are acceptable.

REFERENCE INFORMATION: We desire to print or reprint reference information: lists, rosters, abstracts, bibliographies, etc., of use to computer people. We are interested in making arrangements for systematic publication from time to time of such information, with other people besides our own staff. Anyone who would like to take the responsibility for a type of reference information should write us.

NEWS AND DISCUSSION: We desire to print news, brief discussions, arguments, announcements, letters, etc., anything, in fact, if it is not advertising and is likely to be of substantial interest to computer people.

PAYMENTS: In many cases, we make small token payments for articles and papers, if the author wishes to be paid. The rate is ordinarily ½¢ a word, the maximum is $15, and both depend on length in words, whether printed before, whether article or paper, etc.

All suggestions, manuscripts, and inquiries about editorial material should be addressed to: *The Editor*, COMPUTERS AND AUTOMATION, *815 Washington Street, Newtonville 60, Mass.*

NEW PATENTS

RAYMOND R. SKOLNICK, Reg. Patent Agent
Ford Inst. Co., Div. of Sperry Rand Corp.
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. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington 25, D. C., at a cost of 25 cents each.

March 19, 1957 (Continued): 2,785,857/Richard Y. Miner and Quentin J. Evans, New York, N.Y./American Bosch Arma Corp./A range computing apparatus.

2,786,169/Gary Muffly, Oakmont, Pa./Gulf Research and Development Company, Pittsburgh, Pa./A self balancing electromechanical follow-up system.

March 26, 1957: 2,786,628/Tom Kilburn, Davyhulme, Manchester, Eng./National Research Development Corp., London, Eng./An electronic digital computing device.

2,786,629/Raymond G. Piety, Bartlesville, Okla./Phillips Petroleum Co., Del./An electrical computer for solving phase equilibrium problems.

April 2, 1957: 2,787,417/Joseph W. Northrup, New Orleans, La., and Glenn A. Schurman, Whittier, Calif./California Research Corp., San Francisco, Calif./A geological anomaly gravity analog computer.

2,787,418/Merritt L. MacKnight, Los Angeles, and James O. Beaumont, Cupertino, Calif./Hughes Aircraft Co., Del./An analog to digital converter system.

April 16, 1957: 2,788,938/Omar L. Patterson, Media, Pa./Sun Oil Company, Philadelphia, Pa./An analog computer or analyzer.

2,789,026/Horace W. Nordyke, Jr., Titusville, Poughkeepsie, N. Y./International Business Machines Corp., New York, N. Y./An error sensing arrangement for magnetic writing devices.

2,789,220/Samuel Lubkin, Brooklyn, and Eugene Leonard, Elmhurst, N. Y./Underwood Corporation, New York, N. Y./A computer pulse control system.

2,789,228/William C. Wiley, Detroit, Mich./Bendix Aviation Corp., Detroit, Mich./An electron multiplier.

2,789,261/Frank J. Hoffman, Jr., Eden Roc, Lattingtown, N. Y./Sperry Rand Corp., Del./A servomechanism control system.

April 23, 1957: 2,789,759/Geoffrey Colin Tootill, Shrivenham, Frederic Calland Williams, Timperley, and Tom Kilburn, Manchester, Eng., and Gordon Eric Thomas, Port Talbot, and David B. G. Edwards, Tonteg, near Pontypridd, Wales/National Research Development Corp., London, Eng./An electronic digital computing machine.

2,789,760/Thomas J. Rey, Hayes, and Rolf E. Spencer, West Ealing, London, England/Electric and Musical Industries Lim., Hayes, Eng./An electrical computing apparatus.

2,789,761/Roger L. Merrill and William Hecox, Columbus, Ohio/The Exact Weight Scale Co., Columbus, Ohio/A cumulative summing system.

2,789,762/Kenneth E. Rhodes, Vestal, N. Y./International Business Machines Corp., New York, N. Y./A dual entry controlling means for accumulators.

2,789,766/Marion L. Wood, Highland, N. Y./International Business Machines Corp., New York, N. Y./A record controlled machine.

2,790,076/Richard K. Mason, Binghamton, N. Y./International Business Machines Corp., New York, N. Y./An electronic storage device.

2,790,109/Earl O. Ruhlig, Summit, N. J./Bell Telephone Laboratories, Inc., New York, N. Y./A shift register circuit.

2,790,160/Ronald Millership, Stanmore, Eng./—/A storage system for electronic computing apparatus.

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The Role of Computers

[Continued from page 19]

Computing Elements, Analog and Digital Computers, the SWAC.

Such a workshop experience will reach the students in some way, some time. Already a junior high student has helped edit the report manuscript, to turn up several errors not caught by his teacher!

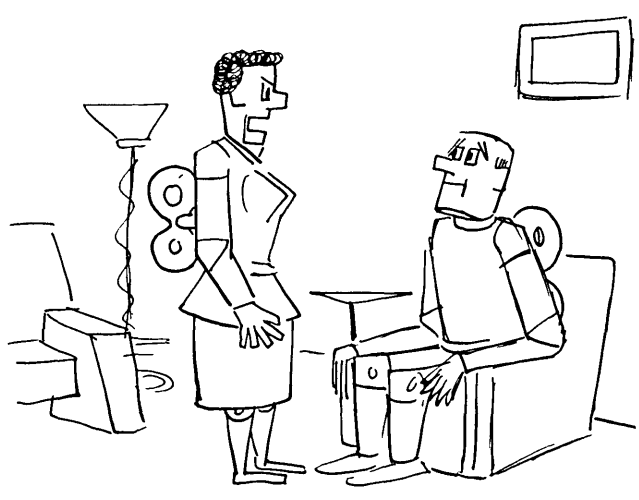
School-Industry Organization In Los Angeles

Organization of the resources of the Los Angeles community was effected by a joint central committee of the Superintendent of Schools, Los Angeles. Leaders at the management level of both industry and education agreed upon a plan of action. The widespread availability of professional positions for teachers this summer is indicative of the success so far enjoyed. Planning for the broader Southern California area will proceed at a week-long conference at Lake Arrowhead, July 7-13. This is under the joint sponsorship of the National Academy of Sciences and Hughes Aircraft Company, with co-operation of the University of California, Los Angeles.

The conference will review and evaluate pilot programs across the nation and dwell pointedly on the Southern California situation. It is hoped that both of these planning-action approaches will serve as incentive and example for community-school cooperation across the nation.

Conclusion

Computers will have a role to play in high school science or mathematics education, and the success of the role will revolve about the teacher. The teacher can acquire first-hand knowledge only by hard study and first-hand participation. Industry can thus aid materially by providing the proper opportunities for teachers (and students too).



"I'll shut up when I'm run down."

New Patents

[Continued from page 32]

April 30, 1957: 2,790,599/Paul F. M. Gloess, Paris, France/ Société d'Electronique et d'Automatisme, Courbevoie, France/ An electronic digital adder and multiplier.

2,790,600/William C. Dersch, Los Altos, Calif./—/A nines-checking circuit.

2,790,915/Jon J. McNeill, Wilkinsburg, Pa./Westinghouse Electric Corp., East Pittsburgh, Pa./A flip-flop element for control systems.

2,790,922/Dietrich A. Jenny, Princeton, N. J./Radio Corp. of America, Del./An electron multiplier tube.

2,790,931/Robert W. Schumann, St. Paul, Minn./U.S.A./An electrostatic memory system.

2,790,943/Herbert S. Woodward II, Minneapolis, Minn./Minneapolis-Honeywell Regulator Co., Minneapolis, Minn./A multiple gain amplifier for servo control.

2,790,953/David W. Elson, Buckhurst Hill, England/General Electric Co., Lim., London, England/An electric signaling system of the kind using pulse code modulation.

May 7, 1957: 2,791,746/Ralph B. Bowersox and Chester G. Hylkema, La Canada, Calif./California Institute Research Foundation, Pasadena, Calif./A high speed recorder.

2,791,747/Louis A. Rosenthal and George M. Badoyannis, New Brunswick, N. J./Louis A. Rosenthal/A computing voltmeter.

2,791,764/Harry J. Gray, Jr., Puzant V. Levonian, and Morris Rubinoff, Phila., Pa./U.S.A./An analog-to-digital converter.

2,791,768/Arnold M. Bucksbaum, Cedar Rapids, Iowa/Collins Radio Co., Cedar Rapids, Iowa/A remote control apparatus.

May 14, 1957: 2,792,174/Donald E. Rutter, Vestal, N. Y./ I. B. M., New York, N. Y./A binary code converter.

2,792,175/Earl K. Amundsen, Torrance, Calif./Hughes Aircraft Co., Culver City, Calif./A card reading station.

2,792,454/Horst Redlich, Berlin-Steglitz, Germany/Teldec Schallplatten G. m. b. H., Hamburg, Germany/A storage apparatus for a plurality of series of voltage impulses.

2,792,455/Horst Redlich, Berlin-Steglitz, and Werner Schmacks, Berlin-Wilmersdorf, Germany/Teldec Schallplatten G. m. b. H., Hamburg, Germany/An apparatus for positioning the recording head of a recording apparatus.

2,792,495/Henry George Carpenter, New Milton, Eng./Elliott Brothers Lim., London, Eng./An electric logic circuit.

2,792,545/Lawrence J. Kamm, Forest Hills, N. Y./Sperry Products, Inc., Danbury, Conn./A digital servomechanism.

May 21, 1957: 2,792,987/George R. Stiblitz, Burlington, Vt./—/ A decimal-binary translator.

2,792,988/Edwin A. Goldberg, Princeton Junction, N. J./ U. S. A./An electronic integrator.

2,793,355/Thomas E. Woodruff, Los Angeles, Calif./Hughes Aircraft Co., Culver City, Calif./An electrical servo system.

May 28, 1957: 2,793,445/Thomas C. Wakefield, Denville, and Joseph E. Gallo, Livingston, N. J./U. S. A./A simulated attitude gyro indicating system.

2,793,806/John L. Lindesmith, Sierra Madre, Calif./Clary Corp., Calif./A readout gating and switching circuit for electronic digital computers.

2,793,807/Robert E. Yaeger, Bedminster, N. J./Bell Telephone Lab., Inc., New York, N. Y./A system for translating information of a continuously variable nature into digital information in accordance with an n digit conventional binary code.

2,794,130/Vernon L. Newhouse, Moorestown, and George R. Briggs, Princeton, N. J./R. C. A., Del./Magnetic core circuits acting as a binary counter.

2,794,173/Robert A. Ramey, Jr., Pittsburgh, Pa./—/A magnetic differentiating circuit.

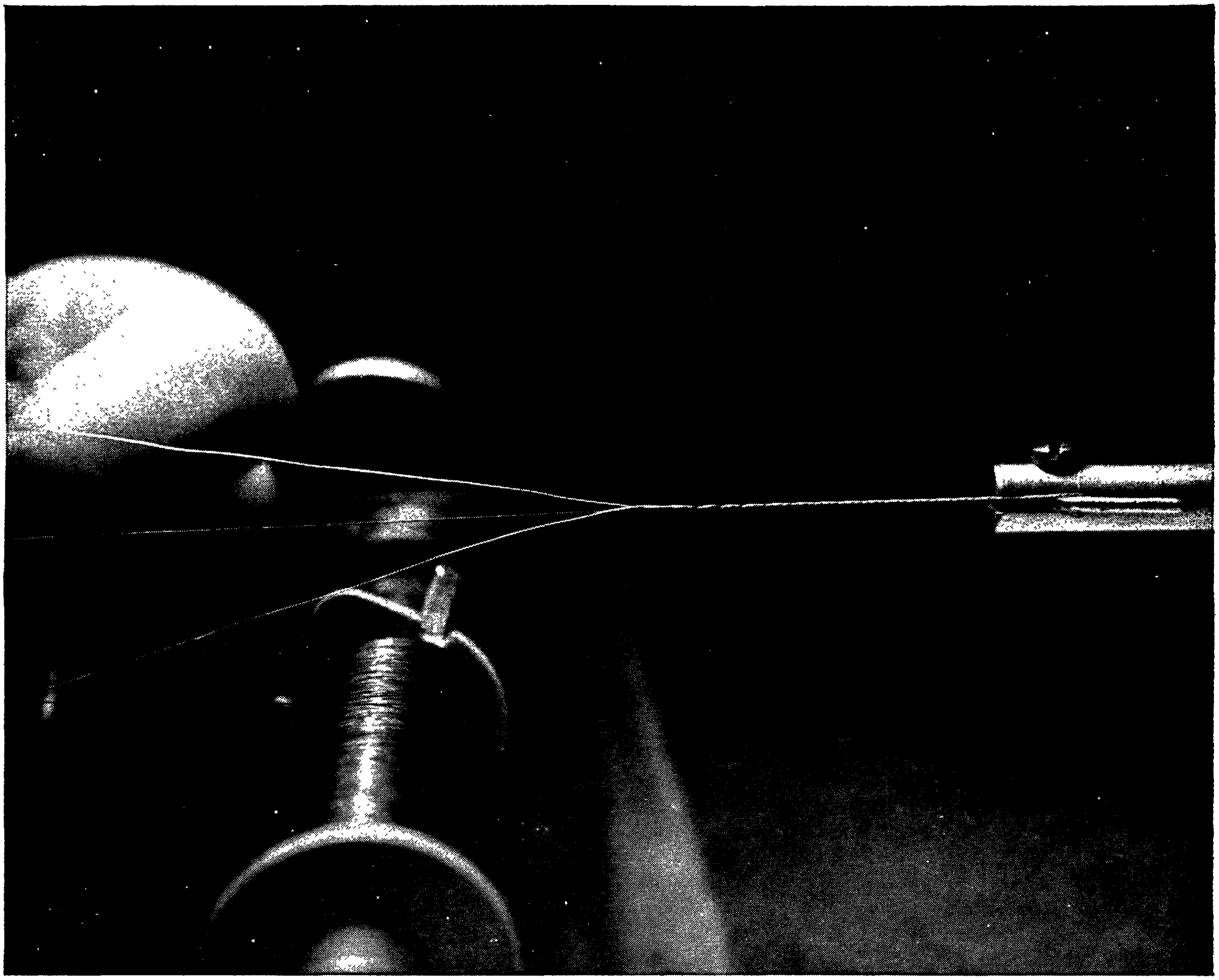
2,794,180/Netardus N. Berger, Los Angeles, and Ambrose D. Plamondon, Venice, Calif./Hughes Aircraft Co., Culver City, Calif./A magnetic drum memory apparatus.

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where it appears / CA number in case of inquiry (see note below) / name of the agency if any.

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 on p. 32 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.



Solderless splice solves problem of open coil windings

STANDARDS THAT DETERMINE RELAY QUALITY/

trouble-free coil windings

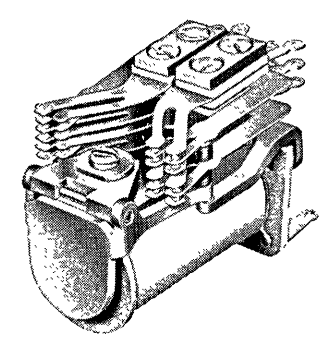
Solderless splice ends failures two ways

The two chief causes of relay coil windings going open in service are: (1) electrolysis, and (2) breaking at the terminal. Automatic Electric prevents these difficulties with a winding termination technique that is vitally different.

We do not attach coil endings of fine wire directly to the terminals. Instead, we carefully strip the insulating enamel from several inches of the coil endings and tightly twist this length of wire with strands of bare tinned copper wire. This strong solderless splice is then insulated with a special film sheet.

Because we make terminal connections over a long section of stranded wire, electrolysis has no single point to attack. And this flexible connection will never snap under temperature extremes or other stress-producing factors.

In every step of relay design and manufacture, we take extra pains to prevent trouble before it starts.



Class "E" Relay *reduces the best of the Class B features to a minimum of space and weight. Write for Relay Highlight #14. Automatic Electric Sales Corporation, Northlake, Illinois.* In Canada: *Automatic Electric Sales (Canada) Ltd., Toronto.* Offices in principal cities.

AUTOMATIC ELECTRIC

A member of the General Telephone System
One of America's great communications systems