A second simplification eliminates the second relay of the second block in each digit. However, the carry from the digit before closes this relay. So just as we needed the A' lead above, we now need a second lead from the preceding digit which will supply power when and only when there is no carry. Therefore, we must also add a circuit to provide this so-called no-carry lead for the next digit. When the contacts of the resulting circuit are combined, the result may be seen in Fig. 4, which is best verified by tracing.

Propermed computers
If all large computers had to be designed with this type of direct circuit, giving you the answer with no further instruction from the operator, their power would be strictly limited by the ingenuity of the designer and the number of operations he could build into a circuit. Large computers use a second type of circuit, called "sequential" because they accomplish their result in a series of steps, as opposed to the "combinational" circuits described above. In these circuits, a simple computer of the combinational type is retained to perform each of the steps, which consist of simple operations.

Memories must be added to store intermediate results between operations. A common set of wires called a "bus," connected to each memory and to the input and output of the computing unit within the enlarged calculator, transfers numbers within the whole framework of the computer.

To control this transfer of numbers as well as the operation being performed by the computing unit, a continuous set of instructions called "programming" is used to tell the computer through the control unit. The actual numbers to be operated on are given to the computer separately, so that this programming will be fixed for a particular sequence of operations—such as involved in solving a quadratic equation, for example.

The 120-relay equipment
It was on this plan that the main computer illustrated in the photograph was designed. Six-digit binary numbers were taken as the basis in which all computations were performed: the memories stored six-digit numbers, the bus carried six-digit numbers, the computing unit operated on six-digit numbers. Rather than breaking the working of the machine down into steps of one operation each, it was further broken into cycles. In each cycle, a number may be taken from one section (e.g. memory, input, output, computing unit or instructions) of the computer and put in another. Thus a step would consist of several cycles which would: 1. put the numbers to be operated on in the computing unit; 2. put the code for the correct operation to be performed in the computing unit from the instructions; 3. take the answer from the computing unit to a memory. The actual computation within the unit is performed automatically once the numbers are at hand. A rough block diagram is given in Fig. 6.

Paper tape was used for the programming, giving the necessary instructions for each cycle in three entries. The first entry determines the section of the computer which is to receive the number. The second determines the section containing the number to be sent and actually connects these through the bus, thus transferring the number. The last entry is provided in case the number to be sent is not in the computer, in which case it will be automatically sent if put on the instructions in this entry. Actually there is another means of putting a new number in the computer: if it is stopped in the middle of the cycle by a special code, a number may be manually connected to the bus with switches as in the simple unit described in Fig. 1.

Memory circuits
The memory (Fig. 6) is the simplest of the individual units within the computer and illustrates the principles for transferring numbers. The actual process of remembering is accomplished by what is called a "holding" circuit. When the relay is temporarily closed by voltage from the bus, a path from the relay