

Disclosure of Magnetic Calculating Machine

To Don
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JGM

A simplified method of constructing a numerical calculating machine is proposed in which some of the mechanical features of an ordinary mechanical calculating machine are retained and combined with certain electronic and magnetic devices to produce a speedier, simpler machine as well as providing additional features of utility, ruggedness and ease of repair.

A continuously rotating shaft called the time shaft, driven by an electric motor, has at least some of each of the following discs or drums mounted on it:

A) Discs or drums which have at least their outer edge made of a magnetic alloy capable of being magnetized and demagnetized repeatedly and at high speed. Suitable coils and other apparatus are provided to convert electrical pulses or other wave shapes into spatially distributed magnetized sectors on the periphery of these discs, the position and/or phase of these magnetized sectors providing a method of storing, in some usable code, those characters or digits which must be used later or indicated. It should be noted that the direction of magnetization of the sectors is unimportant and may be in any direction relative to the motion or a combination of directions, this being a well known technique. This is analogous to the use of a magnetic tape to record sound except that here linearity is of little importance.

B) Discs or drums having edges or surfaces engraved in such a way as to cause voltages to be induced in a coil arranged near the disc. In any case either the disc or pole piece of the coil should be a magnet. This disc would generate such pulses or other electric signals as were required to time, control and initiate the operations required in the calculations. This is similar to the tone generating mechanism used in some electric organs and offers a more permanent way of storing the basic signals required than would be afforded by the alloy discs referred to above.

C) Discs or drums carrying characters, usually the digits 0 to 9, which can be illuminated by a light modulating device, say a neon gas discharge lamp, and so arranged that at any desired phase of the rotating shaft, corresponding to the positions of the characters, they can be flashed thus making one of the characters on the disc visible. This stroboscope principal is to be used as the high speed indication device in this calculator.

Addition, subtraction, multiplication and division would be carried out by processes of successive addition, such as is well known in mechanical calculation machines. The alloy discs or an auxiliary alloy tape could be used to store function data such as a sine table. A multiplication table might be included in this manner to appreciably speed up the process of multiplication by the method of accumulation of partial products used in mechanical calculators.

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Disclosure of Magnetic Calculating Machine

Page Two

The original data or numbers might be put into the machine by means of the usual keyboards, tape or cards. These same types of tapes or cards could be used to record the calculated results.

In the above operations some means must be provided to switch the various signals from one circuit to another. This can be done rapidly by using electronic tubes and switches. A great economy in the numbers of these switching tubes can be effected by putting all the digits of a particular number on the same disc and taking them off serially through the same switching tube. This is to be contrasted to taking the n digits of a number off through n pick-up coils and through n switching tubes.

It has the advantage of reducing the number of tubes required but slows down the operation and may require the mechanical shaft system to be extended so that the alloy discs rotate slower and in synchronism with the indicator discs to allow any of the numbers on the discs to be indicated concurrently or serially. In addition to the above switching operations electronic tubes will be used to count and/or discriminate the pulses used in the system to allow composition of pulse groups from two or more sources and their deposition into other channels. Clearly the power circuits for such a system may be electronic tubes, selenium oxide rectifiers or similar devices.

The use of the binary number system is favored by such an apparatus since the switching circuits are no more complicated and the required pulse groups for representing the number are simpler. The counter circuit is also simpler and more reliable. Either discs of the etched or alloy type may be used to remember combinations required in the conversion from the decimal to the binary system and the reverse if such a system is used.

If multiple shaft systems are used a great increase in the available facilities and for allowing automatic programming of the facilities and processes involved may be made, since longer time scales are provided. This greatly extends the usefulness and attractiveness of such a machine. This programming may be of the temporary type set up on alloy discs or of the permanent type on etched discs.

The principal virtues of such a machine are largely due to the alloy discs which allow numbers to be stored indefinitely and to be put on and taken off by a conveniently controlled electric circuit, and that none of the mechanical parts have to accelerate or decelerate during the operation of the machine. The advantages of the electric control are not only that it allows rapid operation but that the design is simplified and capable of more readily being extended and interconnected to other apparatus.

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Disclosure of Magnetic Calculating Machine

Page Three

Several economies of operation result. It should be cheaper to build, because the precision of the electric parts is much smaller than the equivalent mechanical parts. Maintenance should be reduced because of the reliability and long life of the electric parts, the residual mechanical parts having only very simple bearing surfaces capable of giving long life. The coil structure used to magnetize the alloy discs may be separate from those used to reproduce and demagnetize them, although in the interest of simplicity it should be possible to produce all these operations with the same coil assembly. An economy over card and tape machines may be effected since no materials are normally used up in the operation of the machine, only electric power is consumed.

J. Presper Eckert, Jr.

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