AN AUTOMATIC COMMUTATING DEVICE FOR MULTICURVE STRAIN RECORDING

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Experiments in which one instrument records reading of several transducers require commutating devices.

The commutator whose schematic (in the nonoperative condition) is represented in Fig. 1 can serve up to 100 transducers.

Relays A and B constitute a pulsating pair which provides pulses for the electromagnet (EM) of a step-by-step selector. Switch T₁ provides in position 1 access to all the transducers and in position 2, to one at a time.

Push-button K serves to start the commutator by operating relay A over circuit 0-1. The normally open contact A₁ closes circuit 2-2 and energizes relay B. In its operation, relay B closes the normally open contact B₁ in the 3-3 circuit, thus operating the electromagnet EM. When button K is released, circuit 0-1 is opened, and relay A is deenergized. Circuit 2-2 is broken through contact A₁, thus deenergizing relay B. In releasing, relay B opens contact B₁ in circuit 3-3; since the circuit becomes deenergized, the electromagnet EM releases, and the step-by-step selector makes one step.

If switch T₁ is in position 2, there will be no repeated operation of relay A (circuit 1-1 is broken), although the driving contact of the selector Dₖ will close after the completion of the step. In order to make relay A operate again, button K must be depressed again, thus making the selector wipers advance one more step.

If switch T₁ is in position 1, circuit 1-1 will be closed after the first step of the selector through contact Dₖ and the normally closed contact B₂. In this position relay A will operate again, etc. The pulse-sending cycle will be repeated, i.e., the depression of button K will in this case connect all the transducers sequentially.

The connecting time of each transducer can be varied between 0.05 and 0.5 seconds by means of the variable resistor R₀ = 3 kilohms and capacitor C = 100 mF, which are connected in the relay B circuit. Relay B is made slow-releasing.

Thus, the pulse-pair of relays, whose pulse duration can be controlled, is the driving element of the commutating device.

Type RKN relays have been used for the pulse-pair, and relay B equipped with a copper ring (basic lagging of the relay).

Spark-quenching circuits are connected across the contacts of relays A and B between the positive supply voltage and the contacts of the relays. These circuits consist of series-connected resistor r = 10 ohms and capacitor C₁ = 1 mF, connected in parallel with the sparking contact.

The basic switching device of the commutator is the step-by-step selector ShI-25/4 which has four multiples of 25 working contacts each. The selector levels are switched by means of relays C, P, R, and Q.

Type TV2-1 tumbler switches T₂, T₃, and T₄ limit the number of connected transducers.
If the switch $T_4$ is in position 2, the sending of pulses is stopped as soon as 26 transducers have been discretely connected, since when the selector returns to normal it opens contact $D_k$, breaks circuit 1-1, and releases relay $A$.

If switch $T_2$ is in position 1, but $T_3$ in position 2, 50 transducers are discretely connected, since relay $C$ is released by the operation of the normally closed contact $E_1$ in circuit 5-5. The normally open contacts $C_4$ and $D_k$ in circuit 1-1 will, of course, remain open, and relay $A$ will be de-energized.

If switches $T_2$ and $T_3$ are in position 1, and $T_4$ in position 2, 75 transducers will be discretely connected, since circuit 1-1 will be broken by the normally open contact $P_4$ after relay $P$ is released by the normally closed contact $E_2$ in circuit 7-7.

Relays $C$ and $P$ are released by the auxiliary relay $E$, which operates over circuit 6-b when $T_3$ is operated, or over 8-b when $T_4$ is in position 2, and breaks circuit 5-5 by its normally closed contact $E_1$, or circuit 7-7 by its normally closed contact $E_2$, thus energizing either relay $C$ or $P$.

Finally, when all the switches $T_2$, $T_3$, and $T_4$ are in position 1, all 100 transducers are discretely connected.

Let us examine the operation of the switching relays when switches $T_2$, $T_3$, and $T_4$ are in position 1. Relay $C$ connects selector multiples I or II. In the initial position the wiper of the first multiple is connected through the normally closed contacts $C_1$ and $P_3$ to the positive side of the supply voltage (circuit 4-4). The remaining selector multiples are not supplied with current. After the 25 transducers have been connected in turn, relay $C$ operates over circuit 4-5 and locks itself through its normally open contact $C_4$ and the normally closed contacts $P_1$ and $E_1$ over circuit 5-5. Simultaneously, the normally closed contact $C_4$ breaks the 4-4 circuit thus deenergizing multiple I, and the normally open contact $C_3$ connects multiple II (circuit 6-6). In circuit 1-1 the normally open contact $C_4$ will close, and relay $A$ will be energized, although contact $D_k$ will remain open in the initial (zero) position of the selector.

After the second revolution of the selector rotor, relay $P$ operates over circuit 6-7, and the normally closed contact $P_1$ in circuit 5-6 unlocks relay $C$. At the same time contact $C_3$ breaks the circuit of multiple II, and multiple I cannot be reconnected, since the normally closed contact $P_3$ is now open. Relay $P$ locks itself through the normally open contact $P_4$ and the normally closed contacts $Q_2$ and $E_2$ over circuit 7-7, connecting through the normally open contact $P_2$ and the normally closed contact $R_1$ the wiper of multiple III to the positive side of the supply voltage (circuit 8-8). In circuit 1-1 relay $A$ is prepared for further operation through the normally open contact $P_4$, which is now closed.

Finally, selector multiple IV is connected through the normally open contact $R_3$ when relay $R$ is operated over circuit 8-9, and locks itself through the normally open contact $R_2$ and the normally closed contact $Q_1$ (circuit 9-9). The multiple III wiper circuit is broken by the normally closed contact $R_4$, which is now open. Since relay $P$ remains locked, circuit 1-1 remains closed through the normally open contact $P_4$, which is still closed, and relay $A$ remains operative.

After the 100 transducers have been connected in turn, relay $Q$ operates over circuit 10-10, and unlocks relays $P$ and $R$ by its contacts $Q_2$ in circuit 7-7 and $Q_1$ in circuit 9-9. Circuit 1-1 is disconnected, since the selector wipers have returned into their initial position, and the pulse-pair stops the sending of pulses. The contacts of the switching relays return to their initial position.

For a further operation of the commutator, it is sufficient to press button $K$. For this purpose any normal open button switch can be used.

The switching relays $C$, $P$, $R$, and $Q$ and the auxiliary relay $E$ are of the quick-operating type RKM, whose operating time and release time must be less than 10 msec. Other types of relays can also be used, providing they are made quick-operating by means of any suitable circuit.

The Shl-25/4 selector contact segments cannot provide a constant contact resistance, and the transducers have to be connected, therefore, to the measuring circuit through relay contacts. The windings of these relays are