OVERLOAD PROTECTION FOR TOGGLE PRESSES

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The launching of the production of ladle and checker bricks from high-alumina starting materials made it necessary to increase the force on the SM-143, PK-630, and SM-1085 presses for the purpose of producing refractories of higher density with improved mechanical properties. The current was increased from 60 to 80–90 A but this produced cases of broken beams and shackles.

The worker who regulates the filling of the mold manually monitors the pressing conditions from an ammeter, which indicates the current consumed by the motor of the press. If an overload is noticed in time, the worker disengages the friction clutch which links the pressing system with the flywheel; if the overload remains unnoticed, the press will be damaged.

In the pressing process, the instant when the power consumption is at a peak (i.e., the current at a maximum) occurs 0.3–0.4 sec before the pressing force reaches its maximum, i.e., in time for the press to be stopped [1].

A given pressing force can be produced by different motor currents depending on the moisture content and grain-size distribution of the mix, the shape of the grains [2], voltage fluctuations in the supply [3], etc.

The disadvantages of existing systems of overload protection [1] are that their circuits are too complicated and are prone to faults, and that they are difficult to adjust owing to the dissimilar settings of the current relays. On the other hand, an automatic protection system relieves the press operator from the task of engaging and disengaging the press clutch with a remote-control lever or press-button.

The present authors have developed and assembled a simplified system of overload protection for toggle presses. In the diagram in Fig. 1 only the protection circuit is shown. The starting circuit for motor M is not shown because it varies from plant to plant and does not influence the protection action.

The power circuit of motor M of the press is supplied voltage over an automatic cut-out F1 of the A3124 type (I_p = 80 A). A TK-20, 150/5 type current transformer TT with an É30, 150/5 type ammeter PA and an RT 40/2.5 type current relay K4 is installed downstream from contactor K5. When the motor is started the coil of the current relay is shunted by the opening contact of relay K2 (any type of relay with a 220-V coil and contacts for a current of at least 5 A) which is a PME-111 type starter.

The control circuit for the clutch and brake of the press contains the following components: a V-64-23 type electromagnet Y for the air valve of the clutch; a switching relay K2 for the clutch and brake; intermediate relays K3 in the form of PME-111 type starters; PKE-111/2 type control keys S1 and S2 for the clutch, and LS-53 type indicator lamps H1, H2; and H3 with PE type resistors R1, R2, and R3.

The action of the system is shown in Fig. 1. In the starting position all components are switched off and the voltage passes through fuse F2. Light H3 on the control panel indicates "Clutch disengaged."

The press operator switches on first the mechanism which feeds the mix into the press, then motor M. The opening contact of relay K2 prevents the spurious operation of the current relay K4 by the starting current.

Next, key S1 is pressed to operate relay K2 which is thereby interlocked by one of its closing contacts while the other closing contact energizes the electromagnet 1 (Fig. 2) of the pneumatic drive of the friction clutch 2 and the pneumatic cylinder 3 of the brake. Valve 4 was set manually by the press operator to the "Open" position beforehand. Clutch 2 is engaged, brake shoe 5 releases flywheel 6, and the press is in operation. The opening contact of relay K2 then opens and the current of motor M of the press passes through the coil of current relay K4.

Relay K4 has been so adjusted that it will not react to nominal current surges during the pressing process. If the pressing force and therefore the motor current exceed the given value (the setting is either 80 or 90 A) relay K4 will be operated, its closing contact (see Fig. 1) will operate relay K3 the closing contact of...
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At the same time, the opening contact of S1 and the closing contact of K3 switch on the lamp register H1 "Clutch disconnected for safety." The setting of relay K4 is determined by experiment and prevents the force in the beams reaching a point where they will fracture. The product will then be of good quality and enhanced density.

After the emergency stoppage of the press the operator reduces the mold charge by remote control and then presses key S1 to reengage the clutch. The opening contact of S1 cuts off relay K3 the opening contact of which then closes so that relay K2 can be operated.

Hand-operated valve 4 (see Fig. 2) facilitates and accelerates the process of adjusting and regulating the press by eliminating the delay involved in the operation of the pneumatic system.

A portable device has been developed at the Plant* (Fig. 3) with which the current relay can be set to 80 or 90 A on all presses. The device (denoted in the drawing by a thin line) is connected in the currentless state to one of the terminals of the primary winding of the current transformer TT which is set to one of the phases of the motor M.

A voltage of 380 V at 50 Hz is fed to autotransformer AT (9 A) and then to a nonstandard transformer Tp (380/8 V, 1.2 kW) the secondary winding of which is connected to a laboratory size current transformer 1TT with an E-30, 150/5 type control ammeter 1PA, and to the primary winding of the main current transformer TT.

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