leave a space of not less than two inches between the ends, as experience, covering a period of several years, demonstrated that the strength of a continuous plate between two rails is not required; also, the cut plate is much cheaper both in first cost and maintenance and can be inspected for insulation without difficulty.

The operating switchboard, the circuits of which are shown in Fig. 3, contain the main protection used for the interlocking apparatus.

The power wires from the main power switchboard pass through this board to the interlocking machine. The ammeter is inserted in the positive wire. By means of this ammeter the leverman may watch the current used to operate the switches and signals, and can tell whether they are working properly.

At Lake and Clinton Streets, several ammeters are placed on the turret of the interlocking machine.

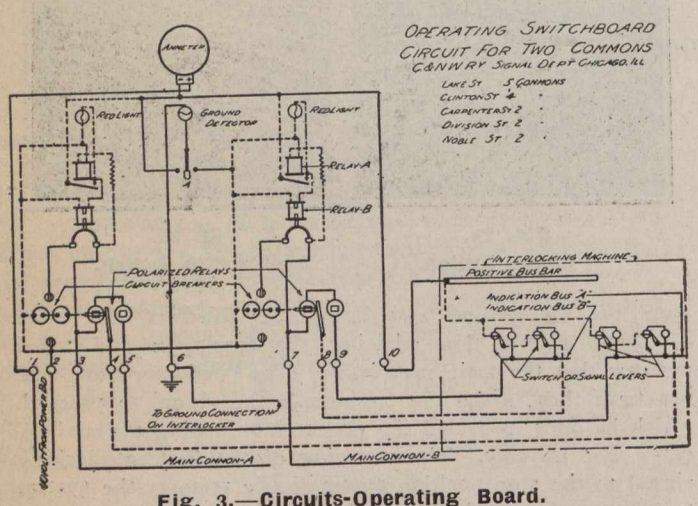

Fig. 3.—Circuits-Operating Board.

The track circuits for the interlocking plants are fed by means of loops from 20-volt storage batteries located in the towers. Two positive and two negative wires are run from the low voltage distributing board to the junction boxes in the section of the plant to be fed. The wires of the same polarity are joined at the end, thus forming loops so that current from the switchboard has two paths to any point on the loop. The loop wires can break at any place, and every point would still receive current.

On the switchboard, ammeter jacks are placed for each wire and again for the main feed wires after the loop wires have joined. A regulating rheostat is inserted in the positive lead capable of cutting the battery down to about 12 volts, at which point it is generally maintained. The track sections are fed from various points on the loop through resistance units placed on each side. These are in most cases 37.5 ohms, although on some sections the resistance has been reduced on one side to meet local conditions. These resistances are of the enclosed fuse type mounted on the terminal boards of junction boxes and manholes. During wet weather, when the leakage between rails increases, the rheostat may be used to allow more current to flow to compensate for this leakage. The purpose of the ammeter jacks is to determine when a break occurs in any of the loop wires. As long as the circuits are perfect the readings are the same, while if there is a break the readings on the No. 1 and 3 wires will be different from the readings on the No. 2 and 4 wires respectively.

In calculating the size of the wire for the loops, one side of each loop was considered cut off at the switchboard and every track circuit occupied except the one nearest the cut-off end.

The voltage required on this last track circuit must be enough to pick up its relay. The voltage on the switchboard being 12, the current used by each shunted track circuit being known, the size of wire is easily worked out. The practical limit to the number of track circuits that could be fed from a loop was found to be 20. Relays of 12 ohms are used on all circuits fed from the track circuit loops. A 12-ohm resistance unit is located in series with the relay to obtain a quick drop-away of the armature, the time being reduced 50% by the insertion of this resistance. This is very desirable on account of the detector locking.

Where the track sections are adjacent to the towers the track relays are located in the tower, but where they are too far away for efficient operation, repeater relays are placed in the tower and controlled by the track relays which are placed adjacent to the track sections.

For the train-shed track circuits two 110 volt to 20 volt direct current to direct current motor generator sets were installed in a relay room under the station platform. These feed direct to the tracks, no storage battery being used, and the sets are run successively in six hour periods.

These motor generator sets are run off the depot lighting system, and by using them instead of a rheostat, the lighting circuits and track circuits are kept separated, and any grounds which may occur on one will have no effect on the other.

At tthe signal bridges at which power-houses are located, the track circuits are each fed from a single cell of 120 ampere hour capacity storage battery with an 8-ohm resistance in series. Relays of 4 ohms are used where the track circuit is fed from these individual cells.

The release route locking circuits operate as follows:—A train entering a route locks up all switches, derails, and movable point frogs in the route, and when the train leaves each track section, all switches, derails, and movable point frogs in that section are released so that they may be moved.

This result is accomplished as follows: The circuits are divided into two general classes—the stick relay circuits and the lock circuits. The stick relay circuits are composed of the stick relay pick-up and the stick relay stick-up wires. The lock circuits are composed of the battery feed wire and the lock wire. The direction in which the locking takes effect is determined by the position of the stick relay, the relay being up when the train is going in one direction and down when going in the other. The relay is picked up by a contact on the sigal governing in the direction requiring the relay up, and is then held up by back contacts on the track relays in the route. The signal in the opposite direction does not pick the stick relay up and consequently it remains down. It will be readily seen that restoring one signal to normal position and clearing the opposing signal will reverse the route locking. This is valuable for switch-engine moves and also for those trains which are too long to completely enter the station and clear the last switch circuits of the interlocking plant.

The levers are controlled by electric locks located on top of the lever, the circuit being held normally open by a contact operated by the lever latch. A white light is in multiple with the lock and latch contact, showing at all times whether the lock can be energized or not. Each lock is controlled directly by the track relay of the section in which the switch is located, thus providing absolute detector locking, making it impossible to operate a switch lever, and therefore the switch, when the section in which that switch is located is occupied. The lock wire receives battery from a back contact of the stick relay while battery is fed to the other end of the route over the battery feed wire, when the stick relay is energized, through the front point of the relay. Thus it will be seen that when a train is going