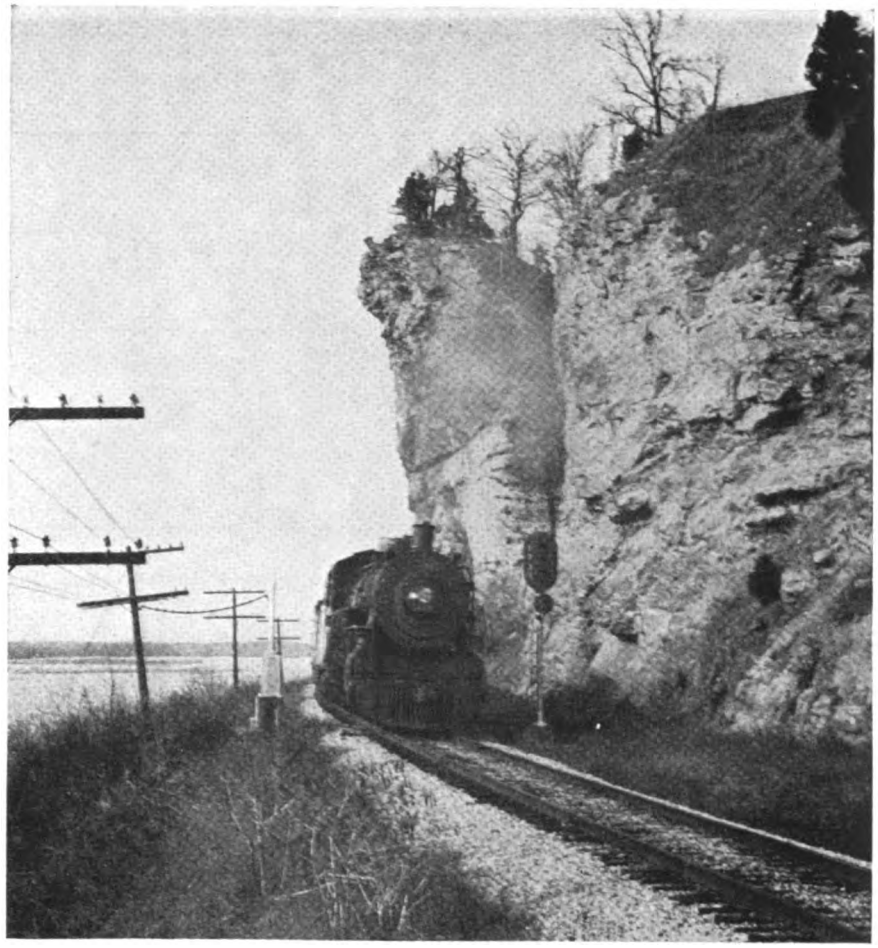
A-C. Primary on the Katy



Heavy freight at signal 1737—Missouri River at left

Primary batteries without rectifiers, normally feeding line circuits, and used also for lighting standby, last from 268 to 857 days, depending on load; and primary battery track cells, feeding the track circuits directly, last from 179 to 272 days, depending on the track circuit characteristics

A RECENT compilation of figures, by the Missouri-Kansas-Texas, on line and track battery renewals, for a section of single track equipped with color-light signals operated on the a-c. primary system with primary battery track circuits, reveals some interesting facts concerning battery life.

The section on which the study was made is a portion of the St. Louis division between Huntsdale, Mo., and New Franklin, 16.6 miles, on the line between St. Louis, Mo., and Parsons, Kan. Huntsdale is 171.7 miles, and New Franklin is 188.3 miles from St. Louis. The line in this territory passes through rolling country and skirts the Missouri river for several miles. Present traffic consists of two freight trains and one passenger train each way daily, and a local freight every other day, or 13 trains every two days.

Twenty-four Style-R color-light signals installed in this territory in 1930, when traffic was heavier, are controlled on the overlap principle, wherein each signal control is extended beyond the next signal in advance governing in the same direction. These are three-position signals, displaying red, yellow or green aspects. The signal control relays are the Type-DP-14, rated at 360 ohms. A slow-release, 400-ohm, DN-11 neutral relay is used as the signal-repeating relay at each signal, contacts of which are inserted in the polarized line control circuits of the control relay for the signal to the rear.

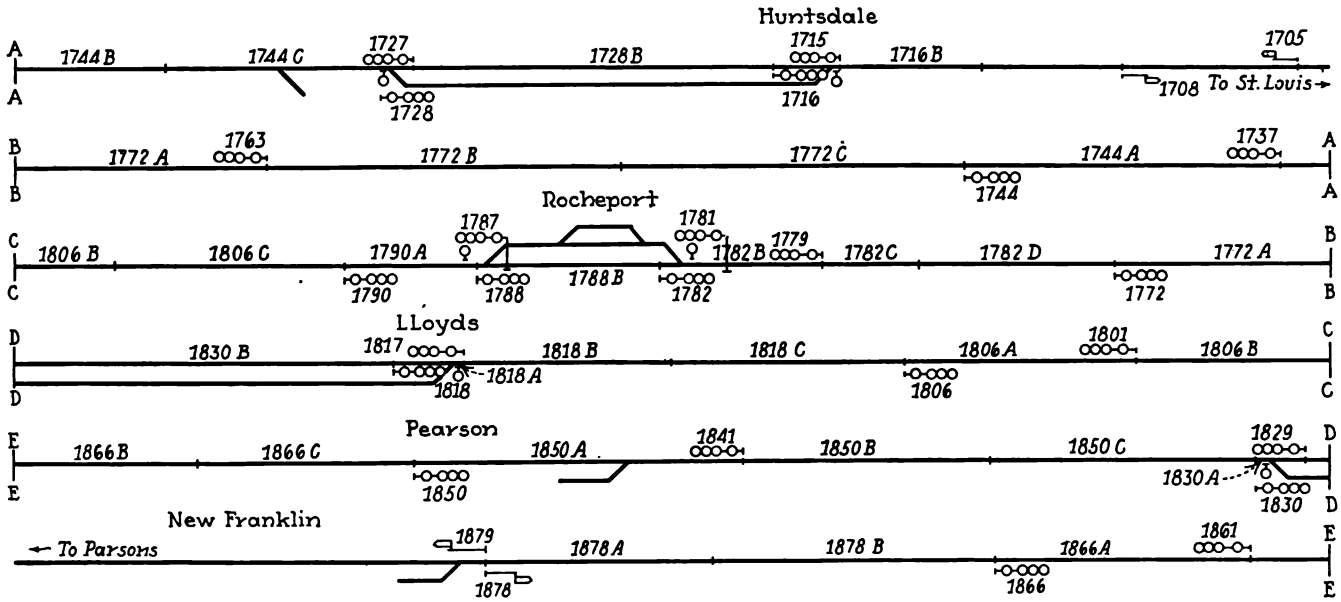
Line Wires

Power is obtained from a commercial source at Rocheport, 6.7 miles from Huntsdale, between Huntsdale and New Franklin, at 220 volts, 60 cycles, and is fed both ways over two No. 6 bare copper wires on porcelain insulators on a Western Union pole line. The power wires are transposed at two points each side of Rocheport to eliminate interference with the telephone circuits on the same pole line. The signals are controlled over No. 10 weatherproof line wire, No. 14 rubber-covered, made up in cable form, with weatherproof wire ties, being used as lead-ins.

Battery Requirements

The signal lamps, which are 10-watt bulbs operated at 7.5-8 volts, are normally continuously supplied with power from the a-c. line by the use of Union Style-NL, 100-v.a. transformers. In case of power failure, an ANL-30 power-off relay transfers the lamp feed to 12 Edison S-500 primary cells connected in series, and the signals are approach lighted. These cells also supply, as a normal load, the d-c. operating relays at each location, as well as the 8-volt, 10-watt lamps of light-type, pushbutton-operated switch indicators whenever used. The line batteries are housed in concrete battery boxes built as an integral part of each signal foundation.

A unique feature of the installation is the use of a yellow color-light emergency unit as a means of avoiding light-out signal failures and re-



The track layout between Huntsdale and New Franklin

sulting train delays. The emergency unit is mounted on each signal mast a short distance below the main signal head. The feed for the emergency-unit lamp is broken over a back contact of an 0.131-ohm, ANL-2 relay, the coils of which are in series with the battery feed wire for the lamps in the yellow and green units of the main signal. Thus, the ANL-2 relay is picked up whenever the yellow or green aspect is displayed in the main unit. If either of the lamps in the yellow or green unit burns out, and fails to light when it should, the ANL-2 relay fails to pick up, and battery is fed over a front contact of the polar signal control relay, over a back contact on the ANL-2 relay, to light the emergency yellow lamp. When a red aspect is displayed on the main signal head, the battery feed for both the green and yellow aspects of the main head and the emergency lamp is broken. The indication of this yellow emergency light, which takes the place of a green or yellow aspect which cannot be displayed on the main head, due to a lamp burnout, is "Approach next signal prepared to stop, and report emergency light burning." When bulbs burn out in the main head, a new bulb is placed in the emergency unit, the lamp from this unit being placed in the red unit, and the red unit lamp being placed in the green unit. The bulbs in the main yellow units are replaced as they burn out, no definite schedule being followed.

Signals 1817 and 1818 at Lloyds

Switch Indicators

Each end of three passing sidings, Huntsdale, Rocheport and Lloyds, is equipped with switch indicators of the illuminated type, with red and green indications. The lamps on the indicators are energized when push buttons, used as battery savers, are operated. The battery feed for these lamps is broken over contacts on a normally-energized 1,000-ohm DN-11 relay, which in turn is controlled over front contacts on the control relays for the signals governing movements over the switch involved. The controls of the signal control relays governing facing movements over any switch are broken through contacts in the switch circuit controller.

Track Circuits Without Bonds

A very unusual feature of this installation is that bonds are not provided on any of the track circuits. The rail is all 90-lb. A.R.A. rail, with four-bolt joints. In order to maintain low rail resistance, the bolts at each joint are tightened once a year, and are treated with a mixture of black oil and kerosene, using a pressure gun to get in behind the angle bars. Each track circuit is fed by either two or three cells of Edison S-500 primary battery in multiple. At signal locations, the track batteries are housed in the same battery box as the line cells, while at intermediate locations, separate concrete battery boxes are provided. At a majority of the locations, the track leads consist of No. 9 two-

Average Life of Line and Lamp Standby Batteries Huntsdale, Mo., to New Franklin 1930-1937

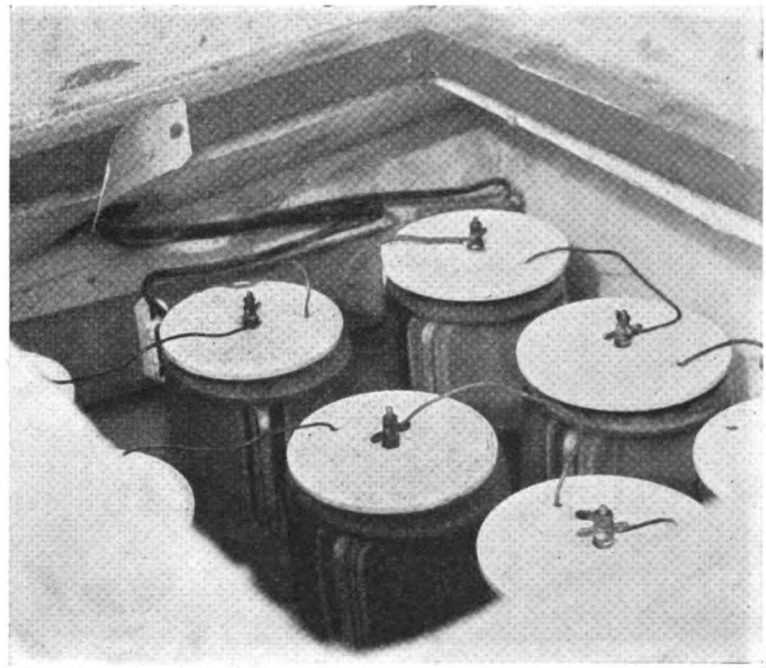
Battery at Signal	Normal Connected Load	Average Life (Days)
1801	1 DP-14, 360-ohm 1 DN-11, 400-ohm	441
1806	1 DP-14, 360-ohm 1 DN-11, 400-ohm	430
1817	2 DP-14, 720-ohm 1 DN-11, 400-ohm 1 DN-11, 1,000-ohm	268
1818	1 DN-11, 400-ohm	825
1829	1 DN-11, 400-ohm	857
1830	2 DP-14, 720-ohm 1 DN-11, 400-ohm 1 DN-11, 1,000-ohm	275

conductor parkway cable, terminated in a pot-head outlet with two No. 9 rubber-covered wires in trunking soldered to track connectors and bonded to the rail with ⅜-in. pins, one track connector going to the inside of the rail and the other to the outside. The track relays are 2-ohm DN-11, four-point relays.

Line Battery Life

The ANL-30 relay at each location is an a-c. relay fed directly from the 100-v.a. transformer. The ANL-2 relays and the signal lamps are normally fed from the a-c. source, but are cut over to the battery in case of power failure, when the power-off relay drops. The 360-ohm, DN-11 signal repeaters and the 1,000-ohm switch indicator control relays are normally fed from the line batteries. The signal control relay for a particular signal is energized over polarized line wires from either the line battery at an opposing signal or the line battery at the signal in advance governing movements in the same direction.

The accompanying table shows the average life of primary cells in line service, together with the connected load for six successive locations in this territory. Few power failures were experienced during the 1930-1937 period for which the data is tabulated. With one 400-ohm relay as normal load, the average battery life was 841 days; with one 360-ohm, and one 400-ohm relay the average life was 436 days; while with two 360-, one 400-, and one 1,000-ohm relays the average life was 273 days.



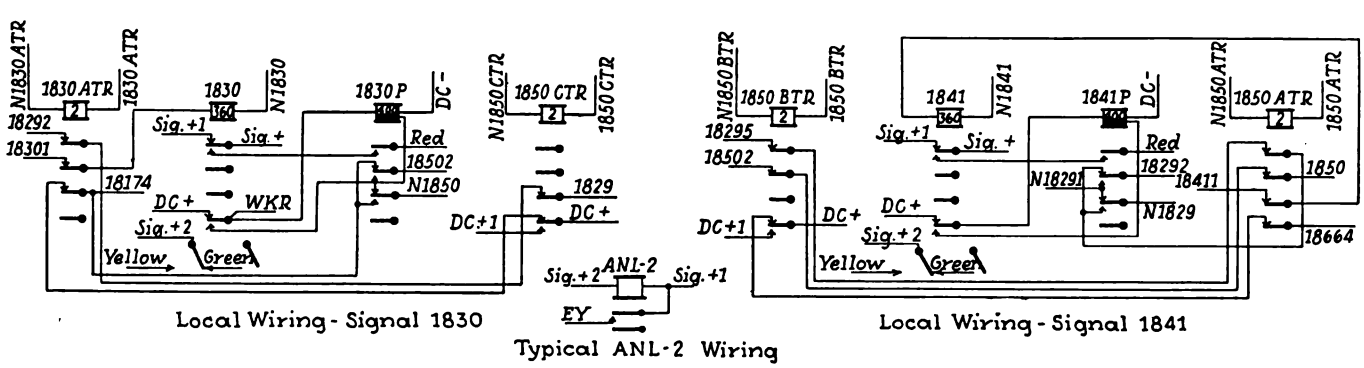
The primary cells are located in concrete battery boxes

Average Life of Track Batteries Huntsdale, Mo., to New Franklin 1930-1937

Track Circuit	Track Relay	Series Resistance (Ohms)	Length (Ft.)	Number of Cells	Average Life (Days)
1806-B	DN-11, 2-ohm	1.0	2,962	3	252
1806-A	DN-11, 2-ohm	1.0	2,742	3	272
1818-C	DN-11, 2-ohm	1.0	3,052	3	248
1818-B	DN-11, 2-ohm	1.0	2,827	3	252
1818-A	Model 13, 2-ohm	1.5	293	2	190
1830-B	DN-11, 2-ohm	0.6	5,540	3	179
1830-A	Model 13, 2-ohm	1.5	225	2	192
1850-C	DN-11, 2-ohm	0.9	3,577	3	207

Life of Track Batteries

The life of primary cells in track use in this territory is particularly interesting because the joints are not bonded. As shown in the accompanying table, which lists the track circuits, types of track relays, series resistance values, length of track circuits, number of cells and average battery life for eight track sections in the same area as signal 1801 to 1830, the average life of the track cells varied from a minimum of 179 days to a maximum of 272 days. All of these track circuits have crushed rock ballast and all cells are connected in multiple.



Typical wiring at head-block and intermediate signals