A very durable and cheap push-button made at the mines (Fig. 9) consists of a base made out of an old 3-in. rubber pump-valve, with brass castings fastened on opposite ends of the same face. Attached to one of these is a strip of spring-brass $\frac{3}{4}$ in. wide and $\frac{3}{64}$ in. thick. This strip is made to pass over the other casting with a contact-face for closing the circuit, as the circuit-wires are attached to the castings on the leather. These have been found to be the most durable of all the buttons tried, and are cheaply made.

For slope-signaling and similar work, bare galvanized wire has been used. The wires are stretched about 6 or 8 in. apart, and when the runner wishes to signal to the engineer he simply presses the two wires together the proper number of times, according to where he is standing.

The most extensive system of signals in use by the above company is at the Auchincloss and Bliss mines, where the two shafts and engine-rooms are equipped with a complete system of call-and-reply signals between head and foot of shaft, these being supplemented with telephone connections.

At this mine there are two shafts; No. 1 is 1,720 ft. deep and No. 2, 1,690 ft. deep, the first seam being about 700 ft. below the surface in No. 1 and 630 ft. in No. 2. Seven seams are operated from each shaft, and the signals for the several landings are arranged in each shaft, as shown in Fig. 10.

Each landing has a separate call to the engine-room, and rings a bell at the same time at the head of the shaft. There is a separate call-and-reply system between the engineer and the head-tender at the shaft.

There is a telephone in each engine-room and one at each landing, and telephone-connection between the two shafts on the surface by an extra cable from No. 2 engine-room to No. 1 shaft. There is also telephone-connection from No. 1 engine-room to the mine office, about three-quarters of a mile away. A complete description of this installation will be found in *Mines and Minerals* for March, 1899.

At the Ontario colliery of the Scranton Coal Co., Mr. Geo. Hawley, electrical engineer for the company, has installed a very satisfactory system of signaling by means of lamps. Four lamps are placed in one circuit in a series and are located as follows: One at the foot of the shaft, one at the head, one in the headman's shanty at the top, and one in the engine-house. These are worked by a switch located at the foot of the shaft, and when the cage is ready to be hoisted the footman throws on the circuit by means of this switch. The lamp at the foot shows that the circuit is working, while the lamps at the head and in the headman's shanty and engine-house show the headman and the engineer that the footman is ready to hoist. Before hoisting, however, the engineer must receive a bell- or hammer-signal from the headman.

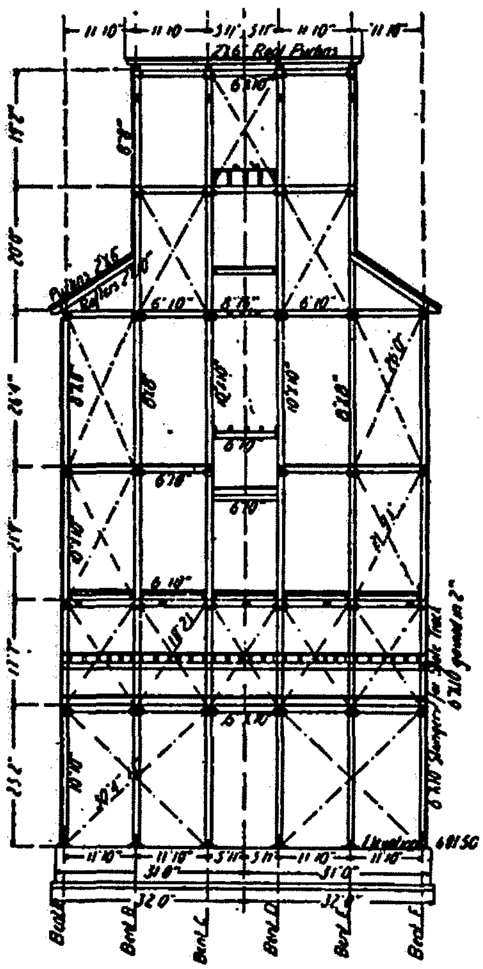
VI. Lighting.

Electric lighting is very general about the breakers and all of the surface-buildings; in many cases it extends to the bottom of the shaft or slope, and in some instances along the main gangways. Most of the mines are lighted from city lighting-stations or from their own plants, generally the latter.

VII. Preparation of Coal.

Until recently the only application of electricity about the breakers was an occasional electric-hoist and electric-lights, but this is a field to which the applications of electricity may possibly be largely extended in the near future, particularly if an extensive experiment now being made by the Delaware, Lackawanna & Western Co. is successful. In order to appreciate the opportunities for electric installations, let us briefly consider the method of preparing anthracite in the breaker, as shown in the accompanying diagram (Fig. 11). The coal is hoisted to the top of the breaker either directly from the shaft or by means of a separate breaker-hoist, or by conveyor-lines. At the top it is dumped upon bars, which in some cases are oscillating. It then successively passes through crushing-rolls which break it, and then over shaking-screens or through revolving-screens which size it. Before reaching the shipping-pockets it must be picked, and in many cases this is done by machinery, while the smaller sizes are jigged. It will thus be seen that there are a large number of separate pieces of machinery in a breaker. Heretofore, these have been run by gearing, by belting, or by rope-drives. The necessity of providing space for any of these forms of transmission is quite a serious problem in the design of a breaker. It is evident, therefore, that any system by which power can be applied directly to each individual piece of machinery and as easily carried as in the case of electric-wires, offers many advantages. In the spring of 1902 the Delaware, Lackawanna & Western Co. put into operation at the Auchincloss colliery an experimental breaker (Figs. 12, 13 and 14), which has a number of

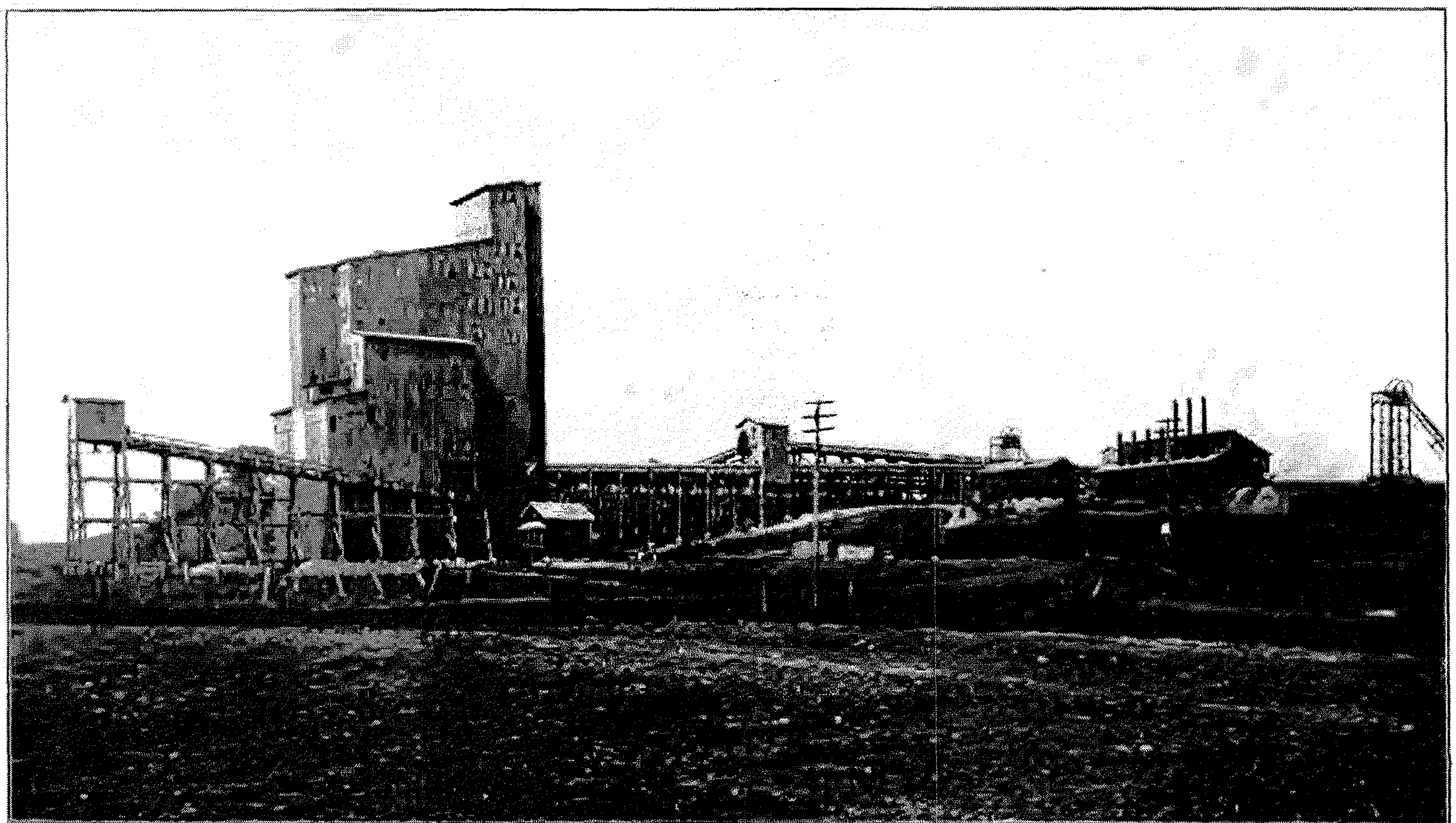
FIG. 13.



End Elevation.
EXPERIMENTAL BREAKER AT AUCHINCLOSS COLLIERY.

unique features in its construction, but which is principally characterized by the fact that it is electrically operated throughout, each piece of machinery being operated by an independent motor. Fig. 12 is a general view showing the arrangement of the plant. The sections (Figs. 13 and 14) illustrate strikingly the contrast between an electrically-

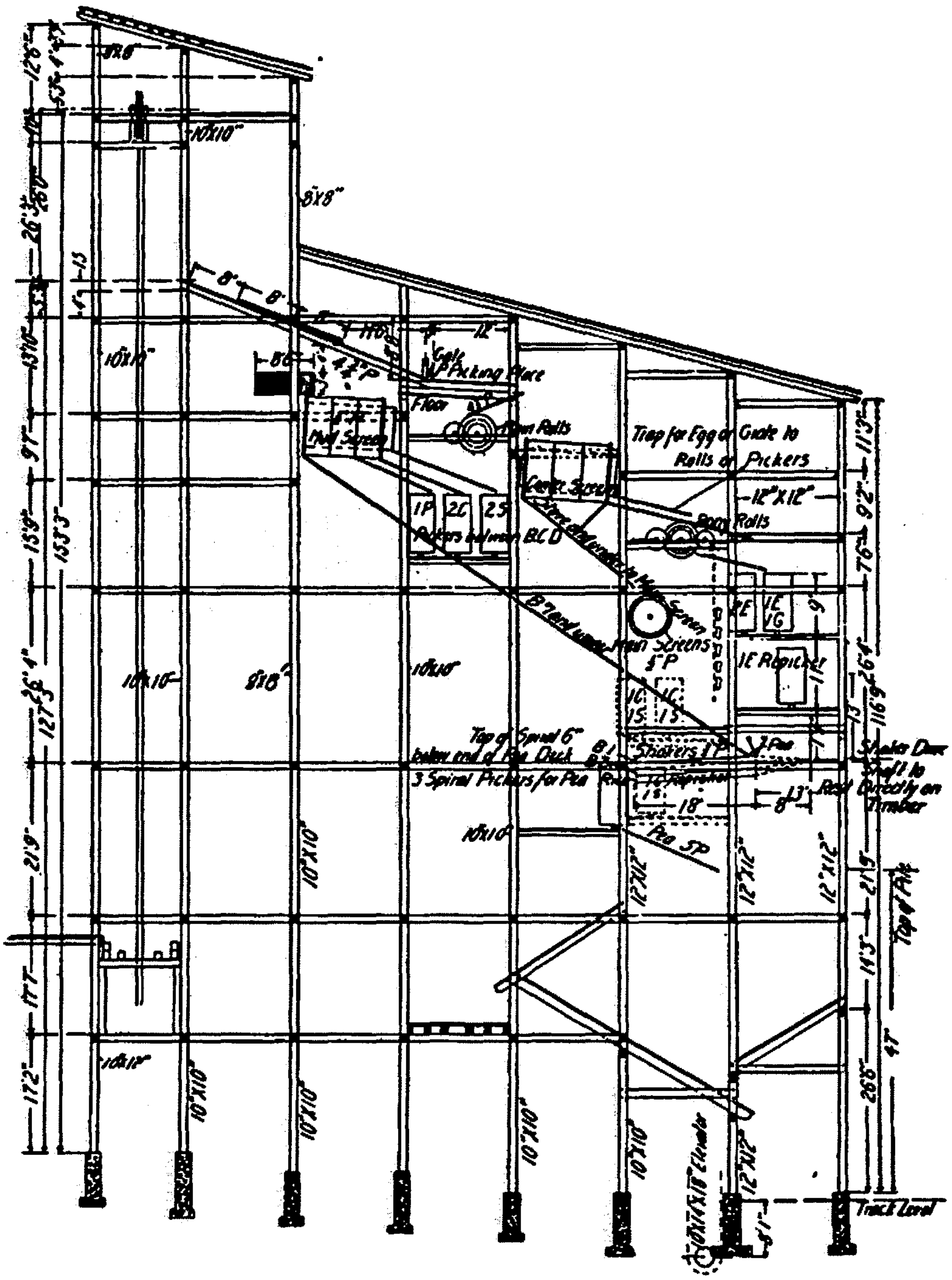
Fig. 12.



General View of the Plant at Auchincloss Colliery.

equipped breaker and one equipped with gearing and belting, the absence of the vibration caused by shafting and belting

Fig. 14.



Side Elevation.
Experimental Breaker at Auchincloss Colliery.

permitting the use of much lighter framing in the electric-breaker.

The electrical equipment of this breaker is as follows:

	K.W.
1 M.P. 4-45-975 generator, belted to Ball & Wood engine,	45
1 M.P. 6-50-280 generator, direct-connected to 13 x 12 Payne engine,	50
	95

Motors.

	H.P.
1 M.P. 4-15-800, driving main rolls,	15
1 C.E. 4-10-650, driving pony rolls,	10
1 C.E. 4-10-650, driving pony rolls,	10
1 C.E. 4-7½-815, driving mud-screens,	7½
1 C.E. 4-7½-815, driving main screens,	7½
1 C.E. 4-7½-815, driving center screens,	7½
1 M.P. 4-15-800, driving shaking screens,	15
1 M.P. 4-15-800, driving elevator-line,	15
1 M.P. 4-25-650, driving fuel conveyor-line,	25
1 M.P. 4-25-560, driving scraper-line,	25
1 C.E. 4-7½-815, driving dust-pan,	7½
1 C.E. 4-7½-815, driving empty car-hoist,	7½
1 C.E. 4-7½-815, driving blower,	7½
1 G.E. 53 R Y. motor, operating loaded car-hoist,	50
	210

All motors are completely enclosed in No. 26 galvanized-iron cases, with a large well-fitting door and with space inside for the rheostat and switches. The cases are fairly air-tight, but are so arranged that they can be easily removed from about the motors when required. Clean air from the outside is forced into these cases from a blowing-fan under a pressure of 2 oz. This prevents the fine dust from the breaker entering the cases and interfering with the working of the motors. It also serves to keep the motors cool. Since the strike came on just as this breaker was ready to start, and the work done after resumption has not given sufficient coal to test its capacity, this device has not yet been thoroughly tried, and may still be said to be in an experimental stage.

VIII. Electricity in the Anthracite-Mines.

The electrical equipment of the anthracite-field at the present time is, approximately, as given in the following table: