"A Modern Compressed Air Power Transmission Plant"

(at the Cleveland Stone Company's Gray Canon Sandstone Quarry
located near North Amherst, Ohio)

In *The Engineering Record*, Vol. 50, No. 2
July 9, 1904, pp. 58-61

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"The compressed air transmission plant recently installed for the Cleveland Stone Company is a typical example of the growing application of pneumatic power to large productive enterprises. The system operates the Gray Canon Quarry of the company, said to be the largest sandstone quarry in the world, and is being extended to supply power to the two neighboring quarries about a half mile distant. The property is located near North Amherst, Ohio, about 30 miles from Cleveland.

The Gray Canon Sandstone Quarry.

"The power house follows the conventional plan of parallel engine and boiler rooms, with provision for extension; the coal bins adjacent to the boiler room provide storage for 650 tons. The boiler room equipment includes three water-tube boilers of 257 rated horse-power, equipped with mechanical stokers and operated under induced draft. A fourth boiler unit of the same size

is being installed to handle the additional load of the two neighboring quarries not contemplated in the original plan. Duplicate feed and circulating pumps handle the feed water through a purifying system which removes all scale-forming matter before the boiler is reached. The exhaust from all boiler room auxiliaries is used in the heater of the purifying system. Automatic regulation of these auxiliaries maintains the water level and steam pressure practically constant.

"Water from an abandoned quarry some distance away is pumped by compressed air through a 3,000-foot pipe line into a storage reservoir close to the power house, and is used for both feed and condensing purposes. Mounted directly above this reservoir is the system of cooling trays adopted to save the power required by a cooling tower. The condenser discharge, flowing by gravity over these trays and from tray to tray, is exposed in tin sheets to the full air-conditioning effect and falls into the reservoir below at a temperature ready for return to the condenser.

"A vacuum of 26 inches is maintained in the plant. Jet condensers, one for each main engine unit, are driven by steeple compound engines, drawing their steam through the coils of the main reheating receiver and discharging their exhaust into this receiver. The cylinder ratio in the main units is such as to provide for this excess low pressure steam and the combination results in an economy in the main two cylinder compounds which is stated to closely approximate that of a triple expansion engine. The condensing water is lifted from the cold well by the condenser vacuum. The condenser discharge flows by gravity to the cooling trays.

"The two main compressor units are steam-driven cross-compound condensing two-stage Corliss air compressors, built by the Ingersoll-Sergeant Drill Company of New York City. At rated speed of 90 revolutions per minute, each unit has a low pressure piston displacement of 6,030 cubic feet of free air per minute and at 100 pounds air pressure, the indicated horse-power is about 1,000. The two distinctive features of these machines are the air valve gear and governor. The air inlet and discharge valves are of the Ingersoll positive air-thrown types, opened and closed at the proper instant by the application of air at two different pressures through an auxiliary controlling valve to the opposite faces of the valve piston.

"There is no chattering of valves. The pneumatic governor supplements a fly-ball governor of usual type. Air receiver pressure acts through a piston and cylinder to change the steam cut-off as the load varies, maintaining the air pressure within the limits of 80 and 83 pounds. The governor is sensitive, positive and quick. The fly-balls operate only when normal speed is exceeded. Air washers in the lower pressure intake conduit exclude grit from the intake cylinder, beside increasing the efficiency of compression by reducing the temperature of the intake air. Each main unit has its individual inter and after-cooler. A circulating pump in the boiler room handles the cooling water for jackets and coolers.

"A five-loop system of distribution piping delivers the air at 83 pounds pressure to every part of the quarry the full volume being available at every point without drop in pressure, without excessive first cost, and without possibility of vital breakdown. The piping has sustained the guarantee under which it was installed by holding full working pressure for 12 hours. Primary, secondary and auxiliary receivers, together with the large pipe capacity, furnish a storage reservoir which absorbs and equalizes the fluctuations of the load.

"The aggregate connected load on the plant is at present about 850 horse-power, while the combined indicated horse-power of the two compressors is about 675. The power is used in

hoists, mill engines, pumps, channelers, drills and forge fires. Reheating to 280 to 300 degrees Fahr. is applied at mill and hoist engines and will be extended to all air motors. The average daily cost of reheating fuel is less than $1 per day for the entire system. The present air plant replaces a standard quarry equipment of steam-driven machines, comprising 31 boilers aggregating 1,200 boiler horse-power, and operating under average conditions of economy. No new machines were introduced; the old ones being simply overhauled and repaired, and connected to the air lines. In some cases the cut-off was shortened. The old boilers, wherever possible, are used as local auxiliary air receivers. When the two neighboring quarries are connected, the total boiler horse-power replaced by the present plant will be 1,800.

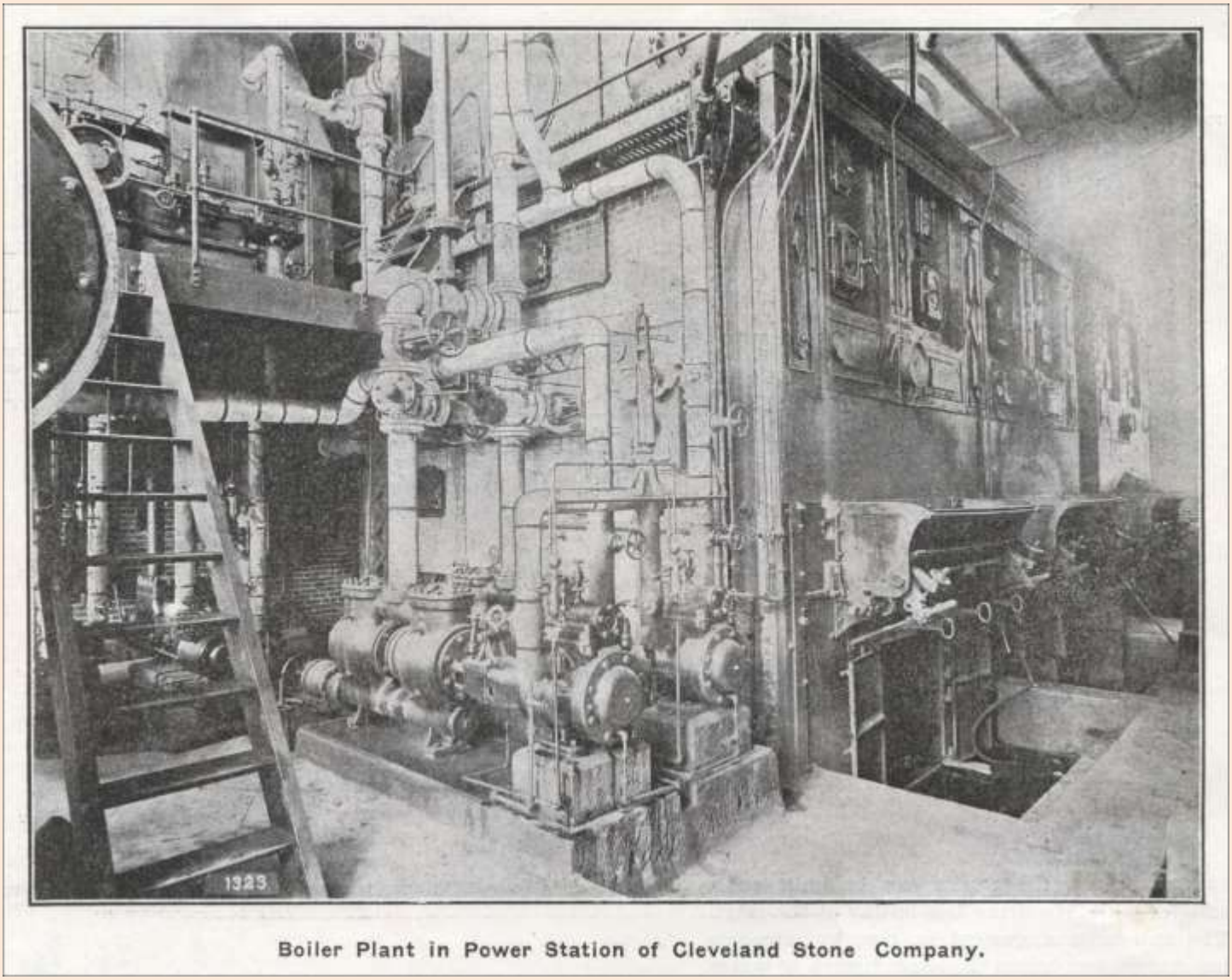
"The system was put in operation on January 2, of this year. Its (sic) continued operation since that time, without shut-down, is notable as effectively and permanently removing the two great obstacles which have stood in the path of progress along these lines – low efficiency and freezing of engines.

"A comparison of the records of the company in April, 1903, shows a coal consumption of 50 tons per day, in 1903, as against 15 ½ tons in 1904; the total labor, fuel and repair charges against the power system were $337.75 per day in 1903, as against $172.80 per day in 1904; a saving by the use of the new power of $164.95 per day. In the face of this great reduction the output of stone in 1904 was larger than in 1903 and was secured with a labor force reduced by 75 men. Figuring this further reduction in labor charges, an estimate shows a daily saving of $275 per day, which may be credited to the new power plant. As to the freezing of the air engines, it need only be said that the entire system has been operated under all sorts of weather conditions without reheating, and no trouble has been experienced from freezing. Reheating is used because of the added economy. The trouble from freezing has been avoided by the complete elimination of moisture from the air by means of the coolers and receivers.

"The plant was installed under guaranteed fuel consumption not to exceed 17 short tons per day, when maintaining the quarry output. That output has been exceeded at a fuel consumption of 15 ½ tons per day.

"The entire plant was designed by Mr. George R. Murray for the Ingersoll-Sergeant Drill Company, of New York, and was installed by that company under his personal supervision. The recorded results mark it as representative of the most advanced practice in pneumatic engineering.

(This article continues on the next page.)



Boiler Plant in Power Station of Cleveland Stone Company.

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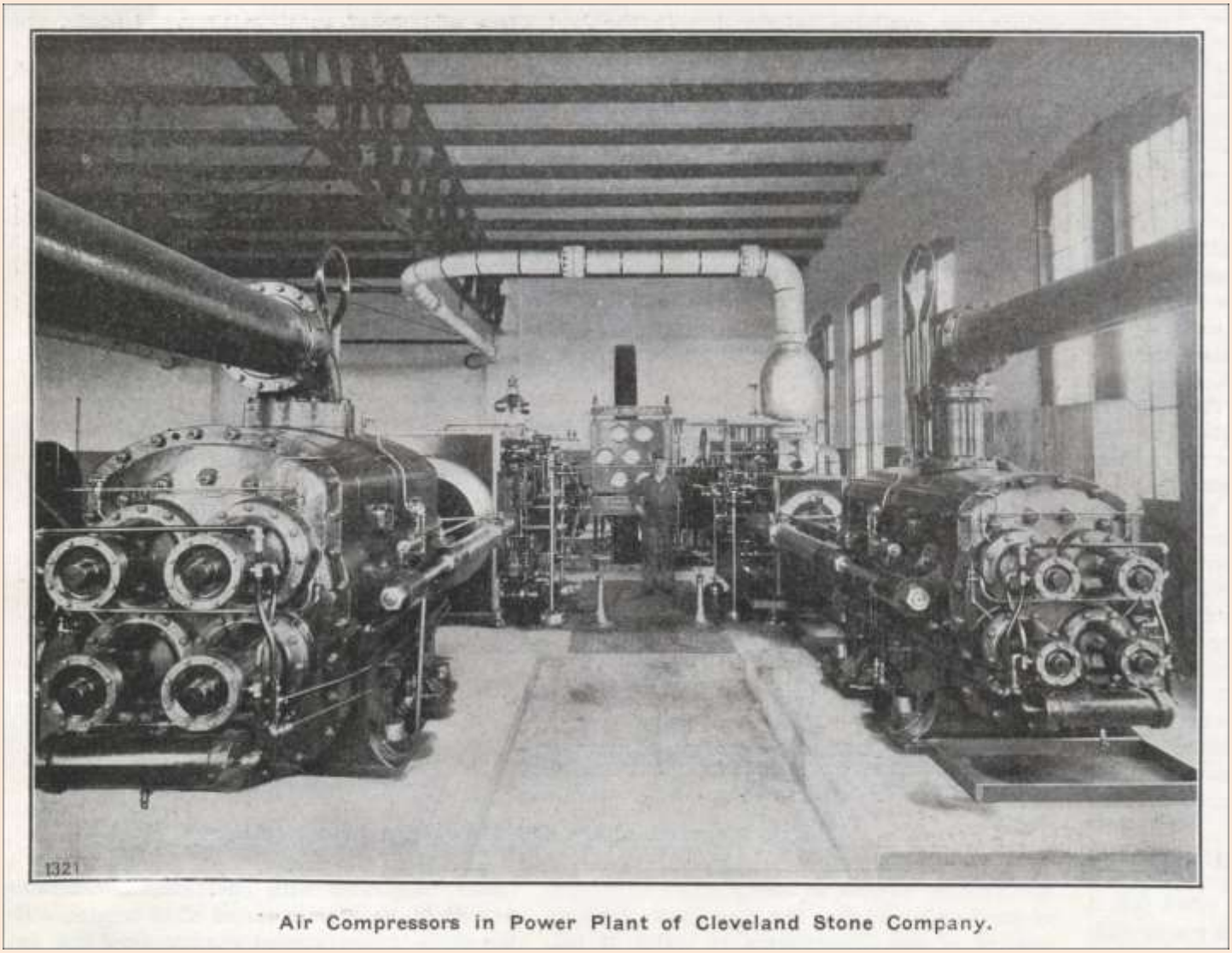

Air Compressors in Power Plant of Cleveland Stone Company.

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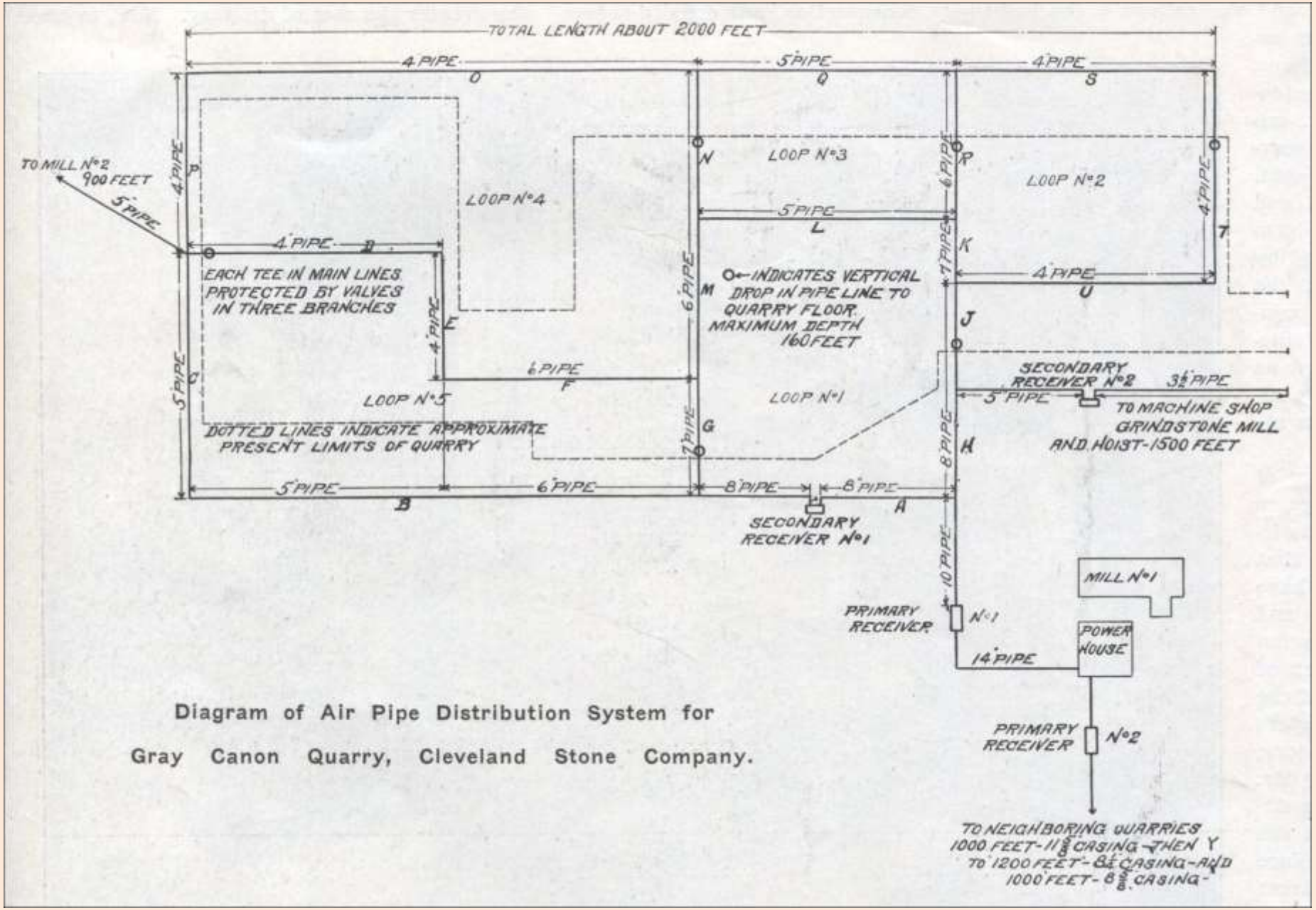

Diagram of Air Pipe Distribution System for Gray Canon Quarry, Cleveland Stone Company.

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