

Charles Clarke to
Charles Porter

Dear Sir,

I would like to know if any alterations in the dimension of cylinder or admission and exhaust pipes have been made since your original design was drafted, of which we have the tracing?

This will determine some particulars in our settings.

We wish to lead your exhaust direct into a large Berryman Feed-water Heater which will show a decided gain in economy¹

I presume that you have no objection to so doing, the aggregate area of the tubes being several times larger than the exhaust.

Mr. Edison gained the impression from Mr. Church of the Buckeye Co.² that you have the impression the dynamo will not be ready for the engine for at least two months. Nearly all the hands in the machine shop are at work upon it and it is being brought very far towards completion and will be so in much less than three weeks. Every part is here and most of them completed. The armature is in such a condition than the whole force can in a few days be put upon it and soon complete it.³

We hope to have the engine in three weeks.⁴ I am, Yours very truly,

C. L. Clarke.

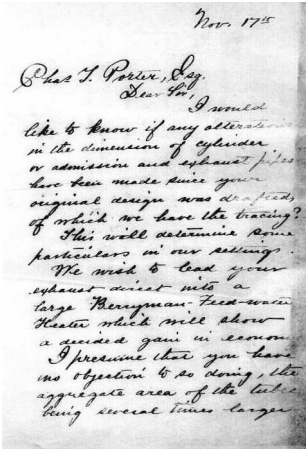
ALS (letterpress copy), NjWOE, Lbk. 6:557 (*TAEM* 80:412; *TAED* LBoo6557).

1. Feedwater heaters were employed to increase an engine's efficiency by transferring heat from exhaust steam to the incoming water before it was injected into the boiler. This particular device, patented in 1872 and made by the Berryman Manufacturing Co. of Hartford, Conn., was in wide use and considered to be among the most effective heaters. Knight 1876-77, s.v. "Feed-water heater"; "Water-Heater, Regulator, and Alarm for Steam Boilers," *Manufacturer and Builder*, 3 (1871): 217-18; "Improvement in the Heating of Feed-Water for Steam Boilers," *ibid.*, 4 (1872): 193-94.

Clarke wrote to Porter on 18 November concerning the shaft dimensions, and again the following day to ask for "a drawing of cylinder giving the details of the admission and exhaust pipes, with exact dimensions." He included a sketch of the proposed connections to the feedwater heater. A week later he asked for the various fittings needed to install the pipes. Clarke to Porter, 18, 19, and 26 Nov. 1880, Lbk. 6:559, 566, 595 (*TAEM* 80:413, 415, 430; *TAED* LBoo6559, LBoo6566, LBoo6595).

2. William Church was a manager of the Buckeye Engine Co.'s New York office. He briefly visited Menlo Park this day. Letterhead of Buckeye Engine Co. to TAE, 24 Feb. 1880, DF (*TAEM* 53:669; *TAED* D8020ZBW); Clarke to Church, 17 Nov. 1880, Lbk. 6:556 (*TAEM* 80:411; *TAED* LBoo6556).

3. Charles Mott's 20 November summary of work during the week indicated that the "Bed plate for Dynamo Engine placed in shop and some preliminary fitting of the parts effected. Discs secured on the ar-

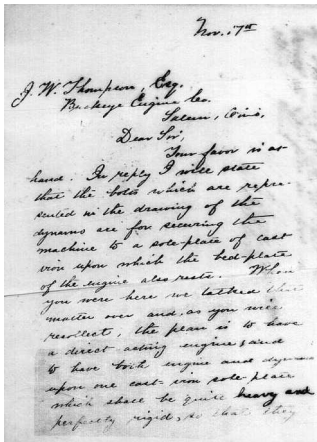


mature shaft, and work on the commutator etc. progressing satisfactorily under Dean.” The next week Mott noted “Dean and several assistants pushing work on the large armature. Logan and others on magnets, base, etc. of large dynamo.” By 2 December the armature disks had been turned on the lathe and were being finished; Charles Dean spent 7 and 8 December soldering the connections. Mott Journal N-80-07-10:214, 225, 229, 236-37; N-80-07-27:137; both Lab. (*TAEM* 37:409, 415, 417, 420-21, 251; *TAED* N117:107, 113, 115, 118-19; N116:70).

4. Edison told a newspaper reporter one week later that he had planned on starting the Menlo Park demonstration on 15 August “but I was disappointed in not getting the steam-engine ordered from a firm in Philadelphia and promised before that date. I have not yet received the engine, but it is now positively promised me in a little more than two weeks.” Charles Mott recorded that the Porter-Allen engine was delivered to Menlo Park on 4 January, 1881, although the engine shaft was delayed at least another week. “Edison’s Work,” *New York Tribune*, 26 Nov. 1880, Cat. 1241, item 1547, Batchelor (*TAEM* 94:618; *TAED* MBSB21547X); Mott Journal N-80-07-10:274, Lab. (*TAEM* 37:439; *TAED* N117:137); Clarke to Porter, 10 Jan. 1881, Lbk. 6:780 (*TAEM* 80:462; *TAED* LBoo6780).

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Charles Clarke to
J. W. Thompson¹



[Menlo Park,] Nov. 17th [1880]

Dear Sir,

Your favor is at hand.² In reply I will state that the bolts which are represented in the drawing of the dynamo are for securing the machine to a sole-plate of cast iron upon which the bed-plate of the engine also rests. When you were here we talked that matter over and, as you will recollect, the plan is to have a direct-acting engine; and to have both engine and dynamo upon one cast-iron sole-plate which shall be quite heavy and³ perfectly rigid, so that they will be self-contained and not be affected by foundations or floors settling and getting out of alignment. As to the design of engine, that is left entirely to you, both in the designing and construction;³ subject of course to the terms of a contract, covering points relative to economy, performance, durability, duration of trial &c, which has yet to be drawn up by us when you are prepared to undertake the construction of the engine.⁴

The nature of the agreement would be such as not to cover any details, but that the capability of the engine to fulfill certain standard requirements may be insured⁵ Yours truly

[C.]^b L. Clarke

P.S. The shaft must be continuous. C.L.C.

ALS (letterpress copy), NjWoe, Lbk. 6:551 (*TAEM* 80:408; *TAED* LBoo6551). ^aObscured overwritten text. ^bNot copied.

1. J. W. Thompson was associated with the Buckeye Engine Co. in Salem, Ohio; nothing more is known of him. Letterhead of Buckeye Engine Co. to TAE, 26 Oct. 1880, DF (*TAEM* 53:911; *TAED* D8020ZIE).

2. Thompson's letter has not been found. At the end of October he asked Edison to stop in Salem on the way to Colorado, where newspapers reported he would soon be traveling, because "We will need the promised drawing of a 'dynamo' machine to which the engine is to be attached if we are to go on and build one, but besides that there are other points on which a little consultation with you would be to our mutual advantage." Thompson also provided some general information about the "plan of engine now nearly perfected which is a modification of the regular automatic [cut-off] so far as relates to the valves and gear." Buckeye Engine Co. to TAE, 26 Oct. 1880, DF (*TAEM* 53:911; *TAED* D8020ZIE).

Edison had an eighty horsepower Buckeye engine installed at Menlo Park in 1878 for testing. In early in 1879 he solicited from the company plans for a 1250 horsepower steam plant and evidently inquired about testing another engine. There is no record that this occurred but in September 1880 he wrote to a manufacturer in Buffalo that he was "making tests of different kinds of engines at Menlo Park. If your No 4 will run 600 revolutions and work at a boiler pressure of 120 lbs please ship one to me immediately" (*TAEB* 4:600 n. 1; Buckeye Engine Co. to TAE, 7 Jan. 1879; TAE to Dunbar & Sons, 29 Sept. 1880; both DF [*TAEM* 50:8, 53:872; *TAED* D7919E, D8020ZHH]). On 8 November Clarke told a Chicago builder that he had learned from Calvin Goddard that "you have a high-speed engine which he understands possesses peculiar merits and might be adapted to running the dynamo-electric machines. If you can give me information as to the type, whether horizontal or vertical, the range of power for which you construct them, the limit to the speed in revolutions to which you can attain, the form of governor and valve gear, and if automatic what would be the smallest engine which you would make automatic? I would like particular information as to one of 120 H.P." Julius Hornig sent another request for information under Edison's signature a few days later. About this time Edison drafted a reply to an inquiry from professor John Trowbridge about acquiring a small engine, explaining that he planned "to make a test with high speed engine with single dynamo & with large engine & number of dynamos (Clarke to Milan Bullock, 8 Nov. 1880, Lbk. 6:529 [*TAEM* 80:404; *TAED* LB006529]; TAE to Bullock, 11 Nov. 1880; TAE marginalia on Trowbridge to TAE, 3 Nov. 1880; both DF [*TAEM* 53:936, 923; *TAED* D8020ZIT, D8020ZIL]).

3. Buckeye engines were noted for their overall excellence and especially for the steadiness and economy afforded by Thompson's form of shaft governor. In this relatively new class of mechanism, the weights were pivoted near the periphery of the flywheel face so that they moved at right angles to the axis of rotation. As they retreated, they adjusted a sliding cam on the shaft which accordingly controlled the steam cutoff. Because movement of the weights was in accord with inertial rather than simply centrifugal force, the governor responded not only to speed but to the rate of change of speed. In general about this time a shaft governor could maintain an engine within two or three percent of a fixed speed. Hunter 1985, 473–80.

4. The next day Clarke wrote a notebook entry stating that “120 H.P. dynamo at 600 revolutions gives 132 Volts. . . . If another magnet is added and only 450 revolutions the E.M.F. will be . . . 132 Volts.” The next day he began making “Calculations for Buckeye Engine The engine to run at 450 which is $\frac{3}{4}$ of 600 revo. for Porter Engine, masses of iron to be made $\frac{1}{3}$ larger.” Over the next several days and again on 6 and 31 December he extrapolated the dimensions, principally of the armature, for the slower dynamo from those of the machine being built for the Porter-Allen engine. N-80-07-27:115-39, 209, Lab. (*TAEM* 37:240-52, 289; *TAED* N116:59-71, 108).

Clarke wrote the Buckeye Co. in mid-December outlining some modifications to their plan for the engine and suggesting the bed plate of the Porter-Allen engine as a model for their own. He offered additional comments and suggestions at the end of the month. Clarke to Buckeye Engine Co., 17 and 30 Dec. 1880, Lbk. 6:684, 736 (*TAEM* 80:441, 453; *TAED* LBoo6684, LBoo6736).

5. Clarke wrote the contract and took it to the Buckeye Co.'s New York office on 2 December (Mott Journal N-80-07-10:228, Lab. [*TAEM* 37:416; *TAED* N117:114]). Its terms were accepted the next week by the Edison Electric Light Co., subject to Edison's personal approval. On 21 December Stockton Griffin drafted a letter from Edison to Calvin Goddard affirming that “an engine which will fulfill the requirements as stated in this contract will prove in every way satisfactory for running the Edison dynamo electric machine.” Edison noted his approval on a similar letter from Clarke the same day, and gave his formal acceptance to the company a few days later (Calvin Goddard to TAE, 10 Dec. 1880; TAE to Goddard, 21 Dec. 1880; both DF [*TAEM* 54:115, 126; *TAED* D8023ZBL, D8023ZBU]; Clarke to Goddard, 21 Dec. 1880; TAE to Edison Electric Light Co., 27 Dec. 1880; Lbk. 6:710, 723 [*TAEM* 80:449, 452; *TAED* LBoo6710, LBoo6723]). The contract has not been found but Charles Mott noted on 29 December that it had been executed by the Buckeye Co. and, perhaps mistakenly, that it called for a 100 horsepower engine running at 450 revolutions (Mott Journal N-80-07-10:265, Lab. [*TAEM* 37:435; *TAED* N117:133]).