The Cover Design

A NEW LOOK AT THE "WHITNEY" MILLING MACHINE

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Some years ago, through research, I convinced myself that the usual attribution of the invention of the milling machine to Eli Whitney was all a bit of careless or hasty scholarship. I reported this conviction in an article written against a publication deadline,[1] which regrettably gave me time to do research only on the negative side of the origin of this important machine.

Because I had given only partial study to the positive side of the question of origins, I felt the article was not ready for publication. My subsequent findings were further delayed because I wanted to tell the positive side in a way that would place the so-called Whitney machine in context with the development of other early milling machines which have, so far, received inadequate attention. Yet having shared some of these later results with others, I think it desirable to publish them now, rather than wait until all the evidence is in, which might be never.

My earlier tentative conclusion was that the milling machine originated in the factory of Robert Johnson in Middletown, Connecticut.[2] That conclusion, based on the published recollections of Edward G. Parkhurst,[3] now serves to illustrate the danger of using uncorroborated evidence.

Simeon North, an arms contractor also in Middletown, together

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[1]Edwin A. Battison, "Eli Whitney and the Milling Machine," *Smithsonian Journal of History,* vol. 1, no. 2 (Summer 1966).

[2]Ibid., pp. 27 and 33.

[3]*American Machinist,* vol. 23, no. 25 (March 8, 1900).

with various associates, lodged a group of affidavits with the Chief of Ordnance in 1852 which describes the priority of some of North's technology of arms manufacturing including mention of the use of milling.[4] These affidavits, including one by Robert Johnson, leave no doubt in my mind that Parkhurst's recollections, published nearly fifty years later, were based on inadequate knowledge, perhaps owing to an imperfect understanding or an incomplete recollection of this evidence assembled in 1852. Parkhurst's statement, attributed to Robert Johnson, that the milling machine he illustrates "was the first [such machine] that he [Johnson] had ever known of," while apparently true as far as it goes, omits the all-important detail that the machine originated with North rather than Johnson.

Regretfully, these letters and affidavits pay more attention to generalities than to a sharp description of the milling machine or a date for its origin. This leaves us pretty much reliant on Parkhurst's date of 1818 for the time of origin.[5] This date is consistent with mention of a milling machine at North's armory in the census of 1820, the only armory to specify such a machine. The 1818 date is also consistent with the absence of any evidence that a milling machine was known to Roswell Lee and James Stubblefield, superintendents, respectively, of the United States armories at Springfield and Harpers Ferry. Lee adopted several innovations quite promptly in 1816 as a result of his examination of North's works and North was at Harpers Ferry within two months to introduce his "uniform system of manufacture."[6]

The date of 1818 is, moreover, prior to John H. Hall's beginning to tool up, at Harpers Ferry in March 1819, to produce his breech-loading rifle with interchangeable parts. Hall eventually utilized a series of important machines, including milling machines which contributed greatly to the facility and accuracy of his manufacturing processes. Although we know nothing about the sources from which Hall began the design of his machinery or when each of the individual machines was completed, there were many avenues by which he could have learned of the latest developments among the armories, including North's milling machine.

Hall was able to complete his original contract for 1,000 rifles early

[4]National Archives Record Group 156, Office of Chief of Ordnance, Box 135, Letters Received 1852. These affidavits were first brought to my attention by Merritt Roe Smith, who was at the time doing research on his doctoral thesis on a Smithsonian grant under my guidance.

[5]Battison, n. 3.

[6]He had already departed by May 9, 1816 (Springfield Armory Letters Received, Record Group 156, Stubblefield to Lee, May 9, 1816).

in 1825 and a second thousand early in 1827. In 1826 a commission was appointed by the War Department to examine his methods and machinery. From this commission's report we know what Hall's outstanding machines were at the close of that year.[7]

Whether there may have been an intermediate milling machine between North's and what Hall in 1826 called his "straight cutting machine," is undetermined. This is the one machine in Hall's shop recognizable as having performed the kind of work which has come to typify the product of a standard milling machine. Aside from the statement of the type of work the machine was designed for—"surfaces either straight and flat or straight and fluted or ribbed and [which] can equally well and with facility be applied to the production of a great variety of other surfaces both regular and irregular"—we get further from the report,[8] "after the work is put into them [they] go thro' with the operation without any further aid from the boy, and when the operation is completed, give notice to the boy, who has been employed during the operation, in putting in and taking out work from other machines."

This is a marked advance in time saving over North's milling machine, which required the constant attention of an operator to feed the work under the cutter manually instead of by means of the self-acting power feed obviously in use by Hall.

The oldest known surviving milling machine, the one called the "Whitney" machine (fig. 1 and the cover design), although known only in its derelict and incomplete state, possesses this important feature of self-acting feed. This feature has been obvious to all from the time the machine was brought to public attention in 1912. However, what has not been previously known is that the feed mechanism is so designed that when the cut is completed the feed may be automatically stopped. Reference to figure 2 shows how this was accomplished. Part *A* is a worm, driven from the cutter spindle by a belt, here shown in the disengaged position. When it is desired to engage the feed, slide *B*, which contains a spring latch, is raised so that the worm *A* is in mesh with worm-wheel *C*. At the same time, latch *D* snaps over the top of the machine base casting at *E*, holding worm and worm-wheel in engagement so that the worm-wheel causes feed-screw *F* to revolve and traverse the "sliding platform," or work

[7]Carrington, Sage, & Bell Report, January 1827, Record Group 156, Chief of Office of Ordnance, Special File, Box 77, Entry 1012. Published in Claud E. Fuller, *The Breech-Loader in the Service* (Topeka, Kan., 1933), pp. 29–32. Also, Brig. Gen. Stephen V. Benet, *A Collection of Annual Reports and Other Important Papers Relating to the Ordnance Department,* Vol. 1, *1812–1844* (Washington, D.C., 1878).

[8]Ibid.

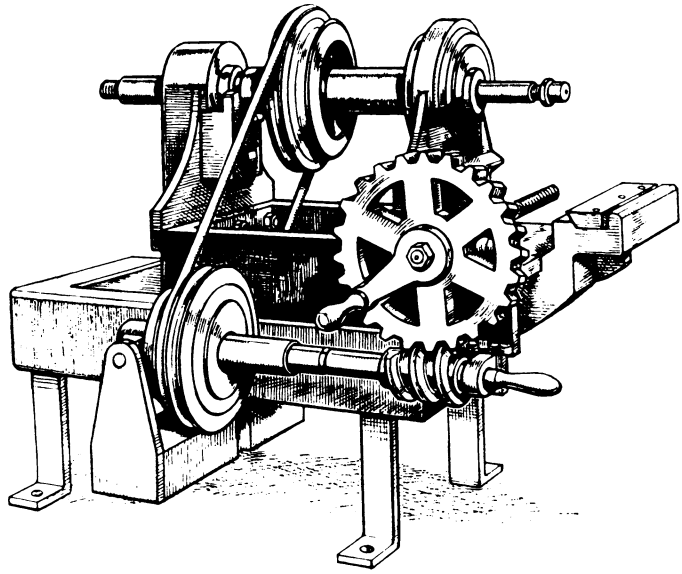

FIG. 1.—"Whitney" milling machine (reprinted from L. T. C. Rolt, *A Short History of Machine Tools,* by permission of M.I.T. Press, Cambridge, Mass. Copyright 1965 by Massachusetts Institute of Technology).

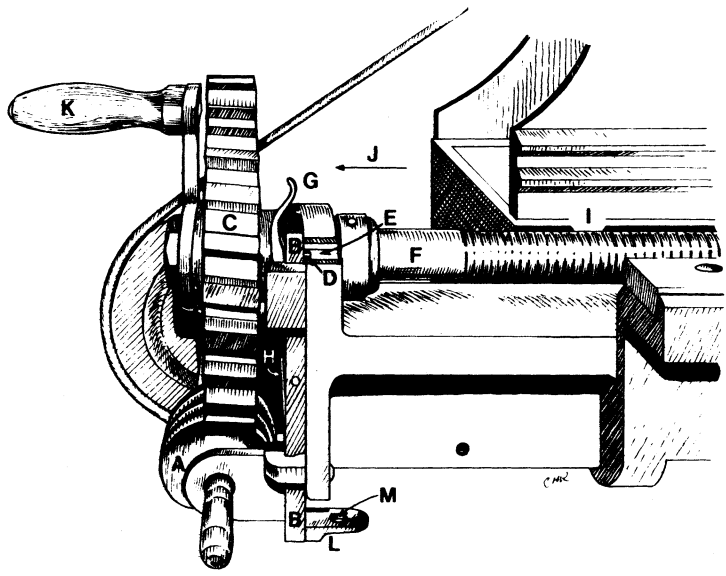

FIG. 2.—Operating diagram of the "Whitney" milling machine

slide, now missing, slowly toward the left carrying the work beneath the cutter (work and cutter not shown). By means of a projection, such as, perhaps, an adjustable rod, extending from the work slide toward the thumb piece *G*, this integral part of latch *D* may be slowly pressed back against the pressure of spring *H* as the work slide moves to the left until *D* is no longer over the machine base at *E*. When this withdrawal has been fully accomplished, slide *B* drops down, carrying worm *A* out of engagement with worm-wheel *C*, thus stopping rotation of feed-screw *F* and traverse of the work slide *A*. Crank *K*, also attached to feed-screw *F*, may be used when the worm is "out of gear" for manual positioning of the work slide and for return of this unseen slide to the point of beginning ready for the start of a new cycle. A small projection *L* from the bottom of slide *B* contains a hole *M*. The function of this detail is unknown; it may have been used as a point of attachment for either a weight or spring which would increase the tendency of slide *B* to drop when unlatched.

It is unlikely that this machine existed during the lifetime of Eli Whitney, for no milling machine appeared on the meticulously detailed inventory of Whitney's estate prepared following Whitney's death in January 1825. Further evidence that it did not exist in his armory consists of the fact that it is not adapted to perform the milling operations known to have been practiced there. Those operations were hollow-milling, akin to drilling, and performed in machinery also used for drilling in various armories years before anyone is known to have had a true milling machine at work.[9]

On the other hand, with both an automatic feed and an automatic stop for the feed,[10] the so-called Whitney machine conforms to all that we know about John Hall's "straight cutting machine" seen and described at Harpers Ferry in 1826. Most interesting in relation to this description is the background of the most prominent member of the three-man commission which reported on Hall's machinery and methods, James Carrington.

Carrington had been employed by Whitney from about the time of his first delivery of muskets in 1801 until just before Whitney's death, when Carrington resigned to become a War Department inspector of contract arms, with Whitney's armory in his territory.

When Whitney obtained his third contract (1822) with the War Department, it was for a relatively rigidly standardized musket being made at both Harpers Ferry and Springfield, as well as by several private contractors. Whitney's product on this contract had to con-

[9]Battison, pp. 21, 23, 24, 28, 29, and figures 10, 11, 12, 13, 14, 15, 22.

[10]Oliver Evans, *The Young Mill-Wright & Miller's Guide*, pt. V, "The Practical Millwright," by Thomas Ellicott (Philadelphia, 1795), p. 79 and plate XI.

form in all ways to the quality and to the price prevailing among his competitors. He had been making a musket originally designed about 1808 under a contract made in 1812. Standards of interchangeability had been far less strict at those dates, and Whitney's contract was for a nonstandard musket which differed markedly in detail from the government-established design of the period. Under these circumstances Whitney had no incentive to keep his armory equipment abreast of that evolving in the other armories, both public and private. Indeed, the inventory of his estate reveals how very scant and how obsolete his equipment was.

Many changes had to be made at the Whitney armory in preparation for competitive production on this third contract. There is evidence to indicate that at the time of his death Whitney was collecting designs and ideas from more advanced armories.

I believe that the popularly called "Whitney" milling machine reflects this collecting of existing technology developed elsewhere and introduced to the Whitney armory as part of its modernization program. Further, I believe that the most likely source for the design of this milling machine is Hall's rifle works at Harpers Ferry. Evidence seems indisputable that this was the most modern and best-equipped armory in the country at just the time when modernization had to be effected as hastily as possible by Whitney's successors and nephews, Philos and Eli Whitney Blake. Certainly James Carrington, Whitney's employee of about twenty-five years and long-time superintendent, could furnish his old "alma mater" with all the necessary details of Hall's machinery as the result of his assignment to the committee that examined and reported on Hall's machinery and methods. Until it can be disproved it seems to me that the most probable date that can be assigned to the "Whitney" milling machine is 1827, following Carrington's study of Hall's rifle works. It further seems that the so-called Whitney machine which embodies all the known features of Hall's "straight-cutting machine" must be regarded as a reflection of that machine. Whether it is a precise reproduction or whether it embodied advances on Hall's machine may never be discovered until Hall's lost drawings of late 1826 or his patent are found. It is pertinent that Carrington in his report suggested that improvements might be made in Hall's machinery if it were to be reproduced.

Hall's machine, it will be remembered, "gave notice" when its work was done. Was this notice in the form of automatic cessation of the table feed as now first reported in the "Whitney" machine, or was it in some simpler form, such as an audible signal so well known on domestic yarn reels of the time? On the other hand, a tripping device suggestively analogous to that on the "Whitney" machine had

been published in 1795 for stopping a sawmill carriage when the saw had reached the end of its cut. Hall's rifle factory occupied what had been a sawmill, and it may easily be that Hall borrowed the idea of automatically stopping at the conclusion of a work cycle from this or some other sawmill. In any case, the basic idea of stopping automatically when the work was done had been published before either Whitney's or Hall's armories were visualized.

Whether or not the reader can accept all that has been presented here, it is to be hoped that both his curiosity and caution have been aroused. Perhaps time and further research will definitely confirm my growing conviction that a more appropriate name for the suspect "Whitney" milling machine would be the "Whitneyville" machine.

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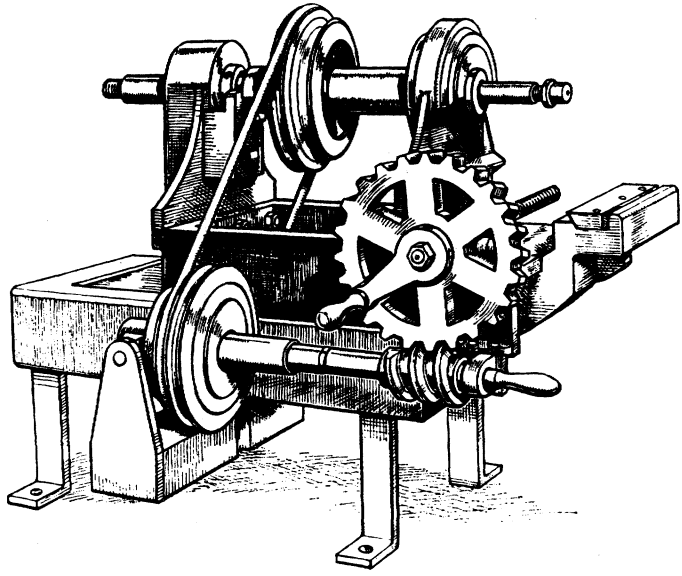

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