History of R. Hoe & Company, 1834–1885

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Edited with an Introduction
by ROLLO G. SILVER

Introduction

FOR THE HISTORIAN of American industry one of the most unreliable sources of information is the 'company history' written by an officer of the firm. The executive-become-historian cannot break his lifelong habit of thinking that profit is more significant than the way to profit. Perhaps unconsciously, the achievements are magnified, the machinations are neglected, the mistakes are overlooked. The result is a conventional promotion-piece rather than a history, and the serious reader finds it difficult to distinguish fact from embellishment. Occasionally there are, of course, less euphoric histories wherein the author supplies the reader with an objective, honest account, thus providing a unique glimpse of the firm. One such work is Stephen D. Tucker's history of R. Hoe & Company.

It is probable that, with the exception of Richard March Hoe, nobody knew more about the history of the firm than Tucker did. He was associated with the firm for almost sixty years and, not being a member of the family in what was essentially a family firm, he retained his objectivity. The article about Stephen Davis Tucker (1818-1902) written by his son-in-law, Colonel Thomas M. Spaulding, for the *Dictionary of American Biography* describes an equable life. Born at Bloom-

field, New Jersey, Tucker entered R. Hoe & Company, New York City, as apprentice in 1834. He gradually rose in rank, became a partner in 1860, and remained with the firm until he retired in 1893. His brilliance in mechanics contributed much to the world-wide success of the house of Hoe. In fact, he devised so many inventions that the number of patents secured approaches one hundred. Obviously Tucker's career was a typical nineteenth-century success story; he was one of those who prided himself on staying the course. He began at the bottom, worked devotedly for the prosperity of his firm, shared in the profits, and, when at the top, received the silver bowls of tribute. During his retirement, he traveled, assembled a collection of sundials which he left to the Metropolitan Museum of Art, and prepared a history of R. Hoe & Company for family use. About fifty years ago, the family deposited typescripts of this history, 'copied accurately,' in several libraries.

Even a cursory reading of the history convinces one that it deserves a wider circulation, if only as a case study of the American Industrial Revolution. The descriptions of the difficulties in obtaining machine tools, the details about the fruitless inventions as well as those about the sources and production of the well-known printing presses, the discussions of patent negotiations and of methods of operation, the emphasis on craftsmanship all explain much about the growth of this manufactory. In addition to the information about printing presses, there are references to the numerous other machines fabricated—a little-known aspect of the firm's activities. Furthermore, the years covered by this history, 1834 to 1885, were the glorious years for R. Hoe & Company. The momentum established in those years enabled the firm to continue until 1969 when it entered bankruptcy. Only Tucker could provide this intimate view of the conduct of one of America's major industrial companies.

According to a letter from Colonel Spaulding, the manuscript of the history was given to the Typothetae of the City

of New York. The library of the Typothetae was transferred to the library of the American Type Founders Company which, in turn, was moved to Columbia University. Apparently the manuscript disappeared during these transfers, for it is not now in the Typographic Library of Columbia University. Therefore the text is taken from the typescript deposited in the University of Michigan Library. In editing, the style of titles has been made consistent and typographical errors have been corrected. All footnotes and illustrations were added.

The editor is very grateful to Mrs. John W. Hazzard and Mrs. Tucker Brooks, granddaughters of Stephen D. Tucker, for permission to print this history. Mrs. Hazzard, Mrs. Brooks, and Colonel Spaulding have been most kind in answering questions during the preparation of this edition.

Messrs. R. Hoe & Company

I began my apprenticeship with Messrs. R. Hoe & Co. in June 1834. Mr. Robert Hoe, Sr. died in 1833 and the firm then consisted of Mr. Matthew Smith, Mr. Richard M. Hoe, and Mr. Sereno Newton.[1] I was indentured to Mr. Matthew Smith, and a very kind master he was.

The works were in Gold Street, and the firm was then making Single Large Cylinder Presses, Two-Revolution Presses, Double Cylinder Presses, Large Cylinder Perfecting Presses

[1] Matthew Smith, the son of a deceased partner of Robert Hoe, Sr., and 'a man of uncommon business talent,' died in 1842. ('R. Hoe & Co.,' *Printers' Circular*, IV (1869-70), 211.) Richard March Hoe (1812-1886), eldest son of Robert Hoe, Sr., (1784-1833) and brother of Robert Hoe, second, (1815-1884), was often addressed as Colonel Hoe because of service in the National Guard. (*DAB*, IX, 104-105; *Appleton's Cyclopaedia of American Biography*, New York, 1888, III, 226.) Sereno Newton 'was regarded as one of the best mechanics of his day.' (Stephen McNamara, 'The Printing-Press,' *Inland Printer*, II (1884-85), 523.) His death was announced in the *Massachusetts Spy*, March 9, 1836, p. 3: 'In Ward, March 2, Mr. Sereno Newton, late of the firm of Robert Hoe & Co., New York, aged 35.'

(Applegath & Cowper's system), Small Cylinder Perfecting Presses (Napier's system), Smith Hand Presses, Inking Machines, Copper-plate Presses, Copying Presses, Type Cases and Stands, Stereotype Blocks, Paper Ruling Machines, Standing Presses, Hand Lithographic Presses; in fact, all the plant then used in a printing office, bindery, and stereotype foundry, even to making inking balls and composition rollers. On the opposite side of the street, in Ryder's Alley, was the Saw factory, in which were made the various kinds of Long and Circular Saws, Cane Knives, Trowels, etc., etc.

A stereotype block with hooks was patented by Mr. Matthew Smith, January 20th, 1819; and Mr. Peter Smith patented the Smith Hand Press April 6, 1822.[2] Mr. Robert Hoe, Sr., patented a 'Standing Press Frame' April 26, 1826.[3] Mr. Sereno Newton had visited England for the purpose of studying the latest improvements in printing and kindred machinery. After his return he obtained two patents dated February 26, 1833; one for improvements in a Double Cylinder Press with rising and falling cylinders, and the other for improvements in a Large Cylinder Perfecting Press.[4]

When I entered the establishment Mr. John Colby was foreman of the Hand Press and Jobbing rooms and forge; Mr. Alexander Drysdale was foreman of the Single Cylinder Press

[2] Matthew Smith, brother-in-law and partner of Robert Hoe, Sr., and 'an ingenious mechanic and worthy man,' died, aged 40, on July 31, 1820. (*New-York Evening Post*, August 2, 1820, p. 2; *DAB*, IX, 105.) Peter Smith (1795-1823), Yale College, Class of 1816, also a brother-in-law of Robert Hoe, Sr. (*Biographical Notices of Graduates of Yale College*, New Haven, 1913, p. 11; *DAB*, IX, 105.)

[3] No patent of that date can be found, but on April 22, 1828, Robert Hoe patented a 'Press, standing, frame, (improvement on Brown's,).' A 'Press, standing, frame,' had been patented by Benjamin F. Brown, New York, on March 2, 1822. (*A Digest of Patents*, Washington, D.C., 1840, p. 309.)

[4] These two patents, 'For *Improvements in the Double Napier Printing Machine*' and 'For an improved *Double Cylinder Register Printing Press*,' are described in Thomas P. Jones, 'American Patents,' *Journal of the Franklin Institute*, New Ser., XII (1833), 102: the improvements in the Napier machine included the application of grippers and the mode of perfecting the sheets; the claim for the other patent is 'combining that part of the Napier printing machine which constitutes the bed, and its appendages, with the cylinders, and such other parts of the superstructure of the Cowper and Applegarth's [sic] printing press as are employed in the receiving and conveying of the sheets.'

rooms; Mr. A. B. Taylor was foreman of the Double Cylinder Press rooms; and Mr. A. S. Bowen had charge of the Pattern and Wood-working Shops. Mr. William L. Colby was a leading man in the printing press rooms, and Mr. James Blair was then running a large slide lathe.[5]

Mr. John Colby was my first foreman and he was pretty testy. Apprentices were not pampered in those days. Laborers were scarce in the factory and apprentices took their places. I recollect that one of my duties while youngest apprentice was to sweep out my department thoroughly every Saturday afternoon.

The works were driven by a steam engine of 12 horsepower, built by the Sebastian Iron Works of this city; and the machine tools consisted of a few hand and slide lathes, a lathe for turning type beds, platens and similar work; drilling machines, a bolt cutting machine, a wheel cutting machine, and a few wood-working tools. Almost all of these tools were made in the works. The forge fires were blown by hand bellows. One cart was sufficient for all the carting. James Yetman was cartman and the horse was a big, black, vicious animal called 'Major.' It was said that when the works were located in Maiden Lane and were driven by a horse mill, 'Major' was the motive power.

The hand lathes were on wooden beds faced with plate iron, and the sliding head and tool rest were fastened in place by a wooden wedge driven between the under side of the bed and a crosspiece which rested in a stirrup that hung down from these parts.

The small slide lathe beds were built up of two cast-iron side plates, bolted to legs, and stiffened by cross braces. The bearings for the main spindle and back gearing were in cross-

[5] John Colby (1786-1858) and William L. Colby (1811-1881) were probably closely related. They are buried in adjoining lots in Green-Wood Cemetery, Brooklyn, N.Y. (Letter from Mr. Neil B. Watson, Superintendent, February 25, 1972.) Alva Burr Taylor (1803-1889) resigned from the Hoe firm in 1842 and later became a competitor in the manufacture of cylinder presses. (Stephen McNamara, 'The Printing-Press,' *Inland Printer*, III (1885-86), 26; *American Dictionary of Printing and Bookmaking*, New York, 1894, p. 537.)

ties bolted across the top of the legs; the cone pulleys were of wood and the holes for all the lathe centers were square. The tool carriage was moved by a rack which ran out several feet beyond the end of the lathe when turning long work. Two or three of the lathes were fitted with a lead-screw for screw-cutting, and these had reversing driving pulleys by which, after a cut had been taken on a screw, the lathe was run backwards for the tool to take the next cut; the clasp nut now used to detach the lead screw and allow the tool-carriage to be run back quickly by hand being then unknown.

The large slide lathe was made by a Mr. Frost, of Brooklyn, and was a unique affair. The bed was a cast-iron triangular bar with sides about 18 inches wide, and on this bar the heads and tool carriage were fitted. It would turn about 3 feet in diameter and was driven by a round gut band, and was precisely like the small watchmakers' lathe we see at the present day.

The drilling machines were a wooden frame hanging down from the ceiling, and carried a drill spindle with a wooden cone pulley. At the top was a wooden beam, one end of which hung in a stirrup, and the other end was attached to the drill spindle. The weight of this beam gave the drilling pressure, and it, together with the spindle, were lifted by a treadle. If more pressure was required in drilling, pieces of old iron were hung on hooks suspended from the beam; if less pressure, some of them were taken off. The drilling table was a portable wooden affair whose top was well soaked with oil and well riddled with holes.

The wheel cutting machine was built by Thomas Freeborn, an excellent, and then well known, mechanic of this city, and was really an extraordinary machine for its day. It would cut spur, bevel and spiral wheels up to six feet in diameter. The divisions of the index plate were originally laid out on a metal circle 20 feet in diameter, with the index plate in the exact center, and from these divisions circles of holes were drilled direct in the face of the index plate with numbers such that the machine would cut teeth of every description from 1 to 100;

every even number from 100 to 200, and every fourth number from 200 to 400. There was also a circle of 1000 smaller holes drilled in the peripheral edge of the index plate, making a total of about 18,000 holes, and the accuracy with which these holes were drilled was surprising. The machine had a built-up frame of cast iron that occupied a floor space of about 6 feet by 10 feet. The index plate was mounted on a vertically sliding arbor on the upper end of which the wheel to be toothed was placed, and the revolving tooth-cutter was carried in a head that could slide horizontally and be fixed at the proper distance from the arbor to suit the diameter of the wheel to be toothed. The weight of the arbor was counterbalanced and its vertical motion was given by a connected lever, the free end of which was weighted to lift the wheel against the cutter with proper force to make the cut, and was then raised by a pair of small pulley-blocks. The vertical motion of the arbor was controlled by a guide-plate, pivoted at its center: for cutting spur wheels the guide was set vertical; for cutting spiral wheels it was set at an angle so that as the arbor rose and fell it also partially revolved. For cutting bevel wheels, a graduated right-angled lever was so arranged that one arm could be connected to the arbor and the other arm to the sliding cutter-head, so that as the arbor rose and fell the cutter-head was drawn back and forth to suit the bevel of the wheel. The cutter-head was altered later to give the cutter a vertically sliding motion, to cut spur wheels with the arbor stationary, and the slide plate could also be inclined forward to give the cutter the inclined motion suitable for cutting bevel wheels. There was also a small rack-cutting apparatus connected with the machine, consisting of a bed with a sliding carriage for carrying the rack and a guide-screw, by which racks could be cut to any desired pitch. The shapes for teeth were not drawn out for the workman in charge of the machine, so he used his own judgment in a measure, but the general rule was, the smaller the wheel the more its teeth should be pointed, and vice versa. This machine was known far and

wide, and quite a business was done in cutting teeth in wheels for the trade. The machine was also more or less copied and many index plates were divided by it for other wheel-cutters, etc. Mr. Sereno Newton compiled for this machine a 'Table of the Proportional Radii of Wheels,' from 10 to 400 teeth, and from ¼" to 3" pitch. This very useful and convenient little book is still in use in the works, it having passed through several editions in the meantime.[6]

Planing Machines, Slotting Machines, Shaping Machines, Boring Machines, etc., were unknown to the firm. The ribs of cylinder presses were first chipped and then planed out with iron hand planes. The plane was about three feet long and fitted with face and side cutting tools. It was drawn forward by a man turning a windlass with the workman standing on the plane to give the required cutting pressure. The plane was carried back, the tool re-adjusted and another cut made. A great deal of care and skill was required at this work and it was surprising how accurately the ribs could be planed. A week was considered a fair time to plane a rib, which was not then faced with steel. The roller frames were made from two flat wrought-iron bars accurately filed by hand to a gauge and screwed together.

The Cylinders of the large Cylinder Presses were built up by keying rings on a shaft and covering them with sheet iron, the impression plate being 3/8 inch thick and the remainder 1/8 inch thick. The bearings for these cylinders were made to slide up and down on two standing bolts fixed into the top of the side frames of the press, and were held down by nuts. To regulate the impression when printing, the nuts were loosened and packing pieces of tin, paper, etc., inserted between the bearing and frame until the proper height was obtained.

The universal joint was a true ball and socket joint, the central ball being 3½ inches or 4 inches diameter and the jaws turned out inside to fit over it. This form admitted of all the

[6] The Library of Congress possesses a copy of the sixth edition of Sereno Newton, *Engineers', Millwrights', and Machinists' Tables* (New York, 1850).

work being done in the lathe. There were no bed plates, but the feet of the side frames were inserted into wooden sills or shoes. Each press was furnished with a stand and fly wheel to be turned by hand, and connection with the press was made by a round gut band.

In 1833 two large Cylinder Perfecting Presses (Cowper & Applegath's system) were built and were for a time in operation at the corner of John and Gold Streets, printing, or reprinting, among other things, *The Penny Magazine*.[7] A Small Cylinder Perfecting Press (Napier's system) was on the floor partly finished in 1834, but was not completed until two or three years later.

The Smith Hand Press, patented in 1822, was an important item of manufacture. The frame was a massive rim of cast iron of an acorn shape, homely but strong. The works gave a powerful impression and for years it was the best press of its kind (Plate I).[8]

Mr. Samuel Rust, in 1829, patented the Washington Hand Press and began their manufacture.[9] The frame was of an improved shape, and the works were more powerful than those of the Smith Press.

Messrs. R. Hoe & Co. wished to buy Mr. Rust's patent, but he refused to sell to them, so Mr. John Colby in 1835, under

[7] 'The unparalleled sale of the "Penny Magazine" in the United Kingdom, as well as the highly valuable, interesting, and useful information contained in the work, induced the Proprietor of this edition to make arrangements with the Publisher in London, for a new and complete set of Stereotype Plates to be cast from the original edition. These plates have nearly all arrived, and the Second Volume is now in course of publication. . . .

Without the aid of Machinery,—which has arrived in this country to great perfection, especially in the art of printing—the "Penny Magazine" could not be published at its present price.' ('Preface to the American Edition,' dated November 28, 1833, *Penny Magazine*, I (1832), ii.)

[8] 'Peter Smith has been given more credit than he deserves. On the strength of a patent of doubtful value, a press was produced which contained no new features worthy of comment. The business ability of the Hoe firm, together with good workmanship, and a heavy, strong design were probably accountable for the success of the press and its long life on the market.' (Ralph Green, *The Iron Hand Press in America*, Rowayton, 1948, p. 13.)

[9] Rust was granted the first patent for his Washington press on May 13, 1821. In the second patent, granted April 17, 1829, 'several improvements are claimed, but they are generally for matters of detail, the principle of the press remaining unchanged.' (Thomas P. Jones, 'American Patents,' *Journal of the Franklin Institute*, New Ser., IV (1829), 57.)

pretense of starting in business for himself, succeeded in buying Mr. Rust's patent right, stock, tools, and shop complete, and continued the manufacture of the presses, but in a short time the business was moved to Messrs. R. Hoe & Co.'s works (Plate II).

I was soon transferred to the Single Cylinder Press room and I recollect that in 1834 we built a Single Large Cylinder Press for Messrs. Day & Wisner, for printing the New York *Sun* and erected it in a basement on William Street.[10]

The inventor of a new Rotary Steam Engine came to the works in the summer of 1835, and wished to test his engine against the factory engine, asserting that he could drive the works with much less steam. His engine consisted of a hollow shaft about three inches in diameter, mounted in a frame, and carried a pair of oval shaped arms about two and a half feet long. The hole in the shaft branched into the arms and ran to their extreme ends where it turned a right angle and terminated in a small opening at one of the sharp edges. Steam entered the shaft and issued from these openings, the recoil from which drove the arms and shaft in the opposite direction. The arms ran in a case having an escape pipe and power was taken from a small pulley on the shaft. When steam was applied the engine started off at a great speed with a hum that sounded like business, but the speed soon slackened and in half an hour it merely crawled around. It was tried with the openings in the arms larger and smaller and with and without a case but the result was always the same. In fact, it was in principle the steam engine invented by Hero more than 2000 years before.

A barrel stave sawing and jointing machine was made for Mr. Charles Ball. The saw was a circular tube the size and

[10] 'We have the pleasure to present our paper, on the birth day of the year, on a sheet of almost twice its former size, without any additional charge to the subscribers. Our establishment is now completely renovated in all its *material;* new and handsome types, from the foundry of the Messrs. Bruce & Co., a new Napier machine press from the manufactory of Robert Hoe & Co., and all the furniture and fixtures also new.' (*The Sun*, January 1, 1835, p. 2.)

shape of a barrel with teeth cut in one end. It was probably an experimental machine and not a successful one.

In 1835-6 a pin-making machine or machines were built for the Howe Pin Machine Co. They were in a private room, so that little was known about them outside, but they were said to be the first machines to make pins with solid heads, instead of the heads being wrapped around the stems as formerly.

The business of Messrs. R. Hoe & Co. was now fast outgrowing their premises, and in consequence a new factory was built in 1835 on a plot of ground 100 feet square on the corner of Broome and Sheriff Streets, then owned by Mr. Benjamin M. Brown, President of the Butchers' and Drovers' Bank. The factory was built 'L' shaped on the two streets and was four stories and basement in height. In the basement was located a high-pressure non-condensing engine of 35 horsepower, from the Novelty Iron Works, of this city; it also contained the grinding shop for saws, etc., the large Frost lathe, the bed and platen lathes and coal cellar. The office and saw shop occupied the first floor; the machine shops were in the second story, the wood-working shops in the third story, and pattern storage and lumber in the fourth story. The blacksmith shop was a one story building on the rear of the plot, and the steam boiler and saw hardening furnace were below ground in the yard space.

The new factory was occupied during the winter of 1835-6 and it was during the removal that the great fire of December 1835 occurred. Mr. A. S. Bowen was made general superintendent of the works; Mr. A. B. Taylor was foreman of the cylinder press department; Mr. Snaith was foreman of the hand press and miscellaneous work; Mr. D. Writner of the blacksmith shop and Mr. J. Wheatman of the saw shop. James Yetman had charge of the stable, etc., which was located on the opposite side of Broome Street. The general business office, however, was retained in Gold Street, and also a repair shop, the latter in charge of Mr. John Colby, which charge he retained until his death in 1858.

The new boiler was of the water-tube class and proved a source of great trouble and expense; the lime from the well water (the Croton was not yet introduced) filled the tubes and they then soon burned out. It was soon replaced by a set of five plain cylinder boilers, which did duty for nearly thirty years. The blacksmith shop was equipped with a large and a small trip-hammer which did excellent service for many years, until superseded by the direct-acting steam hammer. The blast for the forges was given by a blowing cylinder (for fan blowers were not then in use) and the pressure was partially equalized by a tub bellows, a contrivance similar to a gasometer, the upper half of which rose and fell at every stroke of the cylinder. The large Frost lathe was soon replaced by a much larger one, and went to the junk shop. The new lathe was designed by Mr. James Blair, and, somewhat modified since, is doing good service in the works to this day.

The main business of the firm was, of course, manufacturing printing presses and kindred machinery pertaining to the printing business, and also all kinds of long and circular saws. Still, as the new shop was large anything was taken in that was offered and seemed reasonably profitable.

One of the first of the outside machines built was a coining press for Goodell & Harvey. It was the ordinary 'fly press' with screw, lever and balls, and was arranged to punch out the blank pieces as well as to coin them. The frame was of wrought iron so as to be strong and light, for it was said to be destined for the interior of South America, and would have to be transported on the backs of mules. This machine was somehow associated in my mind with the business of counterfeiting.

Then there was a brick-making machine built for Henry L. Pierson from his designs; a very good machine, but too slow; also a cotton gin was built for Dr. Alexander Jones.

A Friction Calender was made for Mr. L. T. Cohen, for calendering sheets of playing cards. It consisted of a polished iron roller running between an upper and lower roller, made up of

disks of paper pressed hard together and turned smooth, the paper preventing the friction (caused by the difference of speed of the rollers) from injuring the surface of the iron roller. The firm had a powerful screw press especially for compressing these paper disks on their shafts.

A transferring press was built for Messrs. Rawdon, Wright & Hatch, bank note engravers. The use of this press is to transfer an engraving on an original hardened steel plate (a design for a bank note for instance) on to a soft steel roller, by rolling the roller back and forth under pressure on the plate. The roller is then hardened and the design transferred in like manner to soft steel plates, which are then used for printing, the originals never being used for that purpose.

A Roller Embossing Machine was made by Mr. John Royle. It was composed of two paper rollers, 17 inches in diameter, having an engraved brass roller running between them, the engraving on which, by running, was impressed into the paper rollers.

A machine was built in 1837 for planing boards, and other thin lumber for Dr. A. G. Hull, under his direction. This was an expensive machine and a number of alterations were made. As finally arranged, the lumber was fed forward by a chain and carried first under rotary cutters. It then passed under a stationary knife fitted similar to the 'iron' of a hand plane, which took off a smoothing cut, but trouble was always experienced by this knife occasionally lifting splinters from the lumber. I never heard how this machine succeeded in practical operation.

The firm now received an order for a hydraulic press, with pump, the first it had been called upon to build. It must have been of quite small size, as it weighed only about 2500 pounds, but I have no recollection of it, and it may have been built in a private room, as a hydraulic press was quite a mystery at that time.

About 1837 the firm built for Mr. Wm. Applegate, a theatrical printer, a mammoth Two-Revolution Press sufficiently wide

to print a long theater poster in one sheet. There was some trouble when the press first started and Mr. Wm. L. Colby was sent to run it until Applegate's hands became competent to take charge of it. I used often to admire these posters on the bill boards in the streets, but when I saw them being printed in Applegate's office, and saw that the cuts of the dashing actresses, etc., were nothing but a pine board carved out with a carpenter's gouge in the roughest kind of a way, I was quite disgusted with the coarseness of the process, and the posters never looked half so attractive to me afterwards.

A circular saw mill running a 46 inch saw was made for Mr. William L. McGhee, and a similar mill was made for him in 1838.

A set of four expensive machines for making wood screws was built for Dr. A. G. Hull, in 1838, and were in hand over a year. These were a heading machine, a head finishing machine, a nicking machine and a threading machine. The screws made had gimlet points, but the threads were cut by a revolving cutter and its teeth left them full of flats, which made them somewhat hard to screw into the wood. Still, they were a great improvement over the imported screws, which were about the only ones then in use. These machines were exhibited in both England and France by Dr. Hull, but, for some reason he never succeeded in getting them into use.

In 1838 the firm made a brass experimental howitzer, 3 inches bore, for the United States Government, under the direction of Capt. Chapman.

A machine was built for Mr. Stacy for dressing stone. This was a heavy, strong machine, with a bed and a movable table, upon which the stone was placed, similar to an iron planing machine. Above these was a revolving cylinder in which numerous steel cutters were inserted for dressing the stone. For some reason the machine did not succeed.

A stave sawing machine, and a stave jointing machine were made for Messrs. E. Peck & Son. The timber carriage of the

sawing machine ran on a track curved to suit the curve of the staves, and the circular saw that cut the staves from timber was 'dished' to the proper curve. In the jointing machine the staves were piled in a trough and the bottom one was continually carried forward by a chain between a pair of circular saws so inclined to each other as to joint its two sides simultaneously.

A small machine for making pills was built for Dr. Peters, which he pronounced very successful.[11]

In 1839 the firm built a perpetual motion, or, as it was modestly called, a machine for creating power. A Mr. Askew was the inventor of this machine, and Dr. William Castle paid the bills.[12] The machine was composed of an upright shaft about two inches in diameter and four feet long, having at its upper end an arm carrying a heavy weight. The bottom of the shaft ran in a swivel bearing, while the upper end ran loosely in a ring about three inches in diameter, and when the shaft was rotated, the centrifugal force of the weighted arm caused the shaft to revolve against the inside of the ring. Eight upright levers about three feet long were grouped around this shaft. Their lower ends were pivoted to the frame work, and their upper ends, guided in grooves, were pressed against the shaft by light springs; so that as the shaft revolved around the inside the ring the ends of the levers would be successively pressed outwards by the centrifugal force of the weighted arm. Connecting rods from these levers operated pawls which worked on ratchets fixed on a windlass drum and caused the drum to revolve slowly. A rope was wound around this drum, to which a heavy weight was attached, so that as the levers were successively pressed out by the upright shaft as it revolved around in the ring, their action through the connections, ratchets and drum, would raise the weight.

[11] Probably Dr. Joseph Priestley Peters, a resident of New York City. (*Longworth's American Almanac . . . and City Directory*, New York, 1838, p. 501.)

[12] Probably Benjamin Askew, a machinist in New York City. (*Ibid.*, p. 66.)

The principle of this machine was based on the well-known law that the centrifugal force of a body moving with different velocities in the same circle, is proportional to the square of the velocity; thus, if the velocity be doubled, which will require double the driving force only, the centrifugal force is quadrupled. Now it was expected that when the upright shaft was rotated at, say, one hundred revolutions per minute by a given expenditure of power, the work produced by the machine in raising the weight a certain distance would be equal to the driving power, less the loss occasioned by friction; and that if the machine were driven at two hundred revolutions per minute, by doubling the driving power, the centrifugal force being quadrupled would raise four times the weight the same distance, and that the power thus produced would not only be sufficient to drive the machine at the double speed, but would have a surplus to more than overcome the friction, and thus be self-operating. And, that if the speed were increased to four hundred revolutions per minute by again doubling the driving power, the centrifugal force would again be quadrupled, thus creating a great power, which would not only drive the machine but would be available for other purposes. But unfortunately, it was found by trial that this expectation could not be realized, and that, in fact, the weight could be raised at any speed by a much less expenditure of driving power when applied direct to the weight than when applied to the machine. This stubborn fact ended that attempt at perpetual motion.

A machine for making bedsteads was built for Mr. Samuel H. Wills. As I recollect the bedsteads, which were of wood, the side and end rails were screwed into the posts by means of a right and left hand screw cut on their respective ends, and these were so adjusted to each other that the shoulder at each end of a rail were drawn up to their posts simultaneously. The machine worked well apparently, for a second one was made immediately after.

Two reciprocating saw mills, a large one and small one,

were made for a Mr. Crosby under his direction, and a veneer saw mill was made for Mr. Charles Simonson.

Up to this time all saws, long and circular, when being ground were held to the grindstone by hand. This method was very slow and expensive, and, for circular saws especially, gave very unsatisfactory results. In 1840 the firm built a machine for grinding long saws (patented by R. M. Hoe, May 30, 1842, caveat 1839).[13] The saws were laid on a reciprocating bed, but instead of a grindstone a leaden wheel was rotated above the saw and fed with a mixture of emery, sand and soapy water.

Machines for grinding circular saws were also built soon after, in which the saw was secured to a revolving face-plate and the leaden wheel traveled back and forth in front of it. These were undoubtedly the first machines ever used for grinding saws; they gave excellent results and were in use for many years, but were finally superseded by our present machines.

A machine was built for Mr. Luther Laughlin for drilling holes in stones for blasting purposes, in which the blow on the drill was given by the recoil of a spring; but the blow was inefficient and the machine was a failure.

A centrifugal gun was made for Mr. Robert McCarthy under his direction. According to my recollection it was composed of a hollow shaft which carried a pair of hollow arms two and a half or three feet long and these were revolved with great speed inside of a tightly fitting case. The balls ran from a hopper into the hollow shaft and thence into the arms, but the case prevented their issuing except at a certain point where it was enlarged to permit it, and here a suitable opening was made in the case to which a tube or gun barrel was attached to direct the balls off. It was said the balls were discharged with so little force in comparison with a musket ball that the device was useless.

An order was now received for a hydraulic press to take the

[13]U.S. Patent No. 2,656, reissued May 5, 1857, No. 462.

place of a screw press for pressing out the indentations in sheets of printed paper. The cylinder was made of cast iron in the usual manner, with a ram six inches diameter, and when the press was put in use the results obtained were so satisfactory that others were soon ordered. But it was found in time that the cylinders were not reliable if the pressure in them exceeded 5,000 lbs. per square inch. Some leaked through pores in the metal, others split open. Increasing the thickness of the walls of the cylinder did not remedy the defects, for with excessive thickness the metal became more coarse grained and porous, and a crack would begin inside the cylinder and spread outwards, while at the outside the metal was yet sound.

It was then decided to make the cylinders of wrought iron, and these, when lined with copper, proved entirely satisfactory. They would withstand a pressure of 10,000 pounds per square inch with safety, and that then became the standard pressure. The firm has continued to build these presses for many purposes, with rams from 4 inches to 20 inches diameter. During the last few years their use for pressing printed sheets has greatly diminished, principally because of the use of hard packing in printing which leaves but a very slight indentation in the paper, and even that little is taken by the signature press now in general use.

About 1839 the New York *Morning Courier and New York Enquirer* imported from London a four feeder flat bed press, Applegath and Cowper's system, such as were then used for printing the London *Times* and other English papers. There were an upper and a lower set of feed boards and fly boards, and the sheets were conveyed in and out of the press entirely by tapes, no grippers being used on the cylinders. But it was found in running the machine that the thin, poor quality of paper used here would so wrinkle and tear and clog the press, and cause such a waste of paper and loss of time, that the use of the machine was impracticable, and after many months of trials and changes by the mechanic who was sent out with it to

erect and run it, the machine was finally abandoned. A year or two later the *Morning Courier and New York Enquirer* gave an order to R. Hoe & Co. for one of their 'improved' double cylinder presses, which when erected, proved capable of doing as much work, and of a better quality than the English press and required only one half the number of hands. I recollect that I helped move the English machine to the factory where it remained for some time, but was finally broken up.

In 1839 Mr. R. M. Hoe bought a second-hand planing machine from Messrs. James Nasmyth & Co., England; the first I had ever seen. It would plane about four feet wide by eight feet long, but we soon enlarged it to plane five and one half feet wide. The table was drawn back and forth by chains which wound around a drum that was driven in opposite directions by a circular double rack and oscillating pinion. This put an end of planing press ribs by hand planes. This was our only planing machine for several years, and the next one was a hand machine made by the Novelty Iron Works of this city. After that, planers of improved construction came fast into use, and in the course of time the old English machine was condemned to the scrap heap.

During these years the firm was constantly building the various kinds of machinery used for printing, stereotyping, bookbinding, etc., especially Single Large Cylinder, Two-Revolution Cylinder and Double Cylinder Presses.

In 1839-40 two bed and platen power presses were built for Mr. Samuel Fairlamb from his designs. These presses, which were very compact and occupied but small floor space, were intended to compete with the Adams press. Both bed and platen rose and fell so that they balanced each other. There were two friskets which were alternately brought in between bed and platen by the motion of the inking roller carriage. The sheets were laid directly upon the friskets, and when printed were removed by hand. Thus while one frisket was having its sheet printed, the printed sheet was removed from the other frisket

and a fresh one laid on it. The machine was quite simple, but was altogether deficient in both speed and power in comparison with the Adams Press.

In 1840 the firm built two 'Pony' Double Cylinder Presses for the New York *Sun*, which were a new departure in this class of machines. The inking apparatus was removed from between the impression cylinders, and the cylinders were made as small as possible and brought close together, thus shortening the travel of the type bed. An inking apparatus was placed outside of each cylinder by which arrangement the form passed twice under the inking rollers to each impression instead of once as previously. The double rack pinion was so enlarged that instead of making five revolutions to one complete run of the bed, as formerly, it now made but three, so that if the bed was stopped and started at the ends of its travel in the same length of time as before, the gain in speed would be 60%. The spiral springs were taken off the bed and placed on the foundation plate of the press in greater numbers, and they acted on the bed through an upright lever at each end of the machine. These levers were pivoted near their lower ends to a support, so that their upper ends could act on the bed through a greater distance without unduly compressing the springs. The impression cylinders were sustained by wrought iron rods instead of the cast-iron slides previously used. These improvements were patented by Mr. R. M. Hoe, May 20, 1842, caveat filed November 30, 1839, (Plate III).[14] These 'Pony' Machines

[14] 'In its general construction this press combines what have been found to be the most valuable of the properties contained in the well known presses invented and patented in England by Applegath, by Cooper [sic] and Miller, and by Napier, upon the particular manner of arranging the respective improvements in these presses, which I have combined in my press. I do not now found any claim to an exclusive right; but I have made certain new and useful improvements in presses of this description, the first of which improvements consists in a novel and efficient arrangement of the levers and springs which are used to stop the momentum of the bed of the press at the end of its traversing motion in either direction; and the second is an improvement in the manner of raising and lowering the pressing cylinders, so as to cause them to rise and fall with the most perfect steadiness, without the possibility of their being subjected to those jerks, to which they have been liable under a rapid motion of the press as heretofore constructed.' (U.S. Patent No. 2,629, p. 1.)

could run 5,000 to 6,000 sheets per hour and the circulation of the *Sun* had increased to such an extent that they were required to run to their utmost capacity, and for a time in 1841 it was my especial business to keep them in order.

It was at this time that Mr. Jeptha A. Wilkinson built for the *Sun* a web press to print from wedge-shaped type, secured to the periphery of a cylinder. The machine was constructed in strict privacy in the *Sun* building. It was to print from a roll of paper and cut and fold the sheets, and its success was believed by its builders to be a certainty. Great expectations were based upon it, and Mr. Moses S. Beach patented it in Great Britain in 1842.[15] Mr. Wilkinson openly boasted that R. Hoe & Co.'s career as press builders would soon be at an end; but, in fact, in spite of all his exertions, he never succeeded in printing an edition of the *Sun* on the machine.[16]

In the winter of 1841-2 I was sent by the firm to New Orleans as pressman for the *New Orleans Bee*, and to repair the presses in New Orleans generally. This kept me there till late in the season and when I returned to New York in the fall of 1842, I found the works temporarily closed, and reorganization taking place. This lasted but a week or so, when business was resumed as before.

Mr. A. B. Taylor, foreman of the cylinder press room, now left Messrs. R. Hoe & Co.'s employ, and went to Connecticut to take charge of the mechanical department in the State prison. He remained there for some two or three years, and then returned to New York, and started in the Printing Machine business. Mr. Wm. L. Colby succeeded Mr. Taylor as foreman of the cylinder press room, a position for which he was well qualified and which he retained until his death in 1881.

During 1842 the firm made a number of grinding mills for

[15] British Patent No. 9,308, March 23, 1842.

[16] A copy of *The Sun*, August 25, 1841, printed as a trial of Wilkinson's press, is in the United States National Archives. (Rollo G. Silver, 'Efficiency Improved: The Genesis of the Web Press in America,' American Antiquarian Society, *Proceedings*, LXXX (1970), 343.)

Mr. James Bogardus.[17] These mills were extremely simple and have been used quite extensively for grinding paint, ink, grain, etc. They were composed of two cast-iron disks, each on the end of a vertical shaft which ran in an upright iron frame. One shaft was placed above the other, but slightly eccentric with it, and the disks were brought together face to face, so that the one drove the other by contact. The faces of the disks were slightly concave and circular grooves turned in them, and as they revolved, the grooves, by the eccentricity of the shafts, passed each other with a grinding or shearing motion. The upper shaft was a tube, and the substance to be ground ran down through it, and was discharged at the peripheries of the disks. These mills were soon in such demand that Mr. Bogardus started a shop for their manufacture.

There was also built a wood planing machine for Mr. Harvey Law from his designs. The material was first roughed down by revolving cutters, and then passed under a stationary knife that was intended to act like a hand plane, and take off a smooth finishing shaving. I recollect there was trouble about getting this knife to act properly.

An Automatic Lathe was made for Dr. Benjamin Brandreth, for turning small wooden boxes and covers for some of his patent medicines. This was designed by Mr. James Blair and worked admirably.

The firm had heretofore had its iron castings made by Mr. Thomas Boyle, and other foundrymen in the neighborhood, but they were in general so unsatisfactory that a foundry was now started in the old blacksmith shop in the Gold Street works, with Mr. John McLaren as foreman. This was a great improvement, for good castings were turned out, and promptly.

About this time the firm concluded to have a private experiment and model room. The rules of the patent office at that time required that every application for a patent should be ac-

[17] 'Upon returning to New York in 1840, Bogardus continued his inventive work and during the next seven years perfected a number of devices. These included a white lead paint grinding-mill, a rice grinder, a new eccentric mill . . .' (*DAB*, I, 407.)

companied by a working model of the invention. Besides, Mr. R. M. Hoe wished to have a number of experiments tried, and it was thought that models and experiments should not be exposed to public view. Accordingly a private room was partitioned off in the fourth story and Mr. James Blair and myself were assigned to it.

In 1842-3 a music printing machine was built for Mr. James F. Starrett, from his designs. This was quite an expensive machine, and was kept in a private room, so that there was but little known of it outside, but I understood that it was on the rotary principle and printed from curved music plates. It was finally taken away, and I never heard anything more of it.

In 1843 Mr. R. M. Hoe applied an air spring to aid in stopping and starting the type bed of a cylinder printing machine (Mr. R. M. Hoe's caveat of July 17th, 1843). A small air cylinder about 5 inches in diameter was secured to the bed plate of the press and a sliding piston fitted in each end, and into this cylinder air was pumped to any desired pressure. The outer end of each piston rod was jointed to the lower end of an upright lever at either end of the press. These levers were pivoted to a support and the compressed air, by its elasticity, acted on the bed in precisely the same manner as the spiral springs previously described. This operated well as long as the proper pressure was kept in the air cylinder, but the air would gradually leak out, rendering the spring ineffective and endangering the safety of the press, so the device was never brought into public use and was never patented.[18]

During this year Messrs. Woodhull and Minturn ordered a ship steering machine for the packet ship *Liverpool* to be built under the direction of Mr. John Cochrane. The device as I recollect it was a tangent screw, working into a curved segment, secured on the head of the rudder post.

[18] Three years later the air spring was patented by Alva B. Taylor and successfully used by him. (U.S. Patent No. 4,442, April 4, 1846; Stephen McNamara, 'The Printing-Press,' *Inland Printer*, III (1885-86), 26.)

The firm had for several years built small steam engines of various styles, but now a new design was adopted for the future. A strong square pedestal was mounted on a solid bed-plate, and on this pedestal the steam cylinder was placed vertically and carried guides for the cross-heads. From each end of the cross-head a connecting rod extended down to the crank-shaft, which was placed beneath the cylinder and ran in bearings in the bed-plate. With a pump and governor attached, this made a very complete, compact and strong engine. The first one made was of 10 horsepower for Messrs. S. W. Benedict & Co., and a great many others, ranging from 5 to 25 horsepower were built during the succeeding 25 or 30 years. Engine building had then become a special business and the firm gradually ceased making them and gave its attention more fully to printing machinery. Some of these engines, however, are in use at the present day.

A large calendering machine was built for Messrs. E. J. Bartow & Co.[19] The iron and paper rollers were 5 feet long and 18 inches in diameter, and it was said to be a very effective machine.

In 1844 the firm built two Flat Bed Perfecting Presses; one for Mr. Isaac Winchester and the other for Messrs. S. W. Benedict & Co.[20] The cylinders made two revolutions to each sheet printed, and rose and fell alternately, and the sheets were transferred from one cylinder to another, the same as in the machines we are now making. But printers, at that time, were not generally in favor of printing both sides of the paper at one operation, although it was known to be extensively practiced abroad. After changing hands several times, one of these machines was destroyed by fire, and the other was finally broken

[19]The firm of Edgar J. Bartow & Co. was engaged in the paper business. (*Doggett's New-York City Directory for 1845 & 1846*, New York, 1845, p. 31.)

[20]An Isaac Winchester does not appear in the New York directory. Undoubtedly Tucker was referring to Jonas Winchester, publisher of the *New World*. Seth W. Benedict was a New York printer. (*The New-York City Directory for 1844 & 1845*, New York, 1844, pp. 34, 383, 412.)

up by us, being superseded by a Rotary Perfecting Press. In the meantime, several foreign machines were introduced, but all fell into disuse, and we made no more of this class of presses for several years.

In 1844 the firm built for Messrs. F. Mason & Son a street sweeping and dirt collecting machine, from their plans. This operated very well on the shop floor, but the streets of New York were too badly paved at that time to permit any sweeping machine to clean them properly.

There was also made for Mr. Philip Church a model of a locomotive for running on both a level and mountainous road. It was like an ordinary locomotive, with the addition of a rack and cog wheel arrangement, to be brought into operation for climbing the mountain road.

Cylinder presses, on account of their speed over bed and platen presses, were now coming into use for a finer class of printing, but it was observed in practice that the edges of the form where the cylinder ran on and off, would receive the whole pressure of the cylinder, with the result of showing corresponding dark lines on the printed sheets. To obviate this, Mr. R. M. Hoe applied a type-high adjustable bearer to each side of the type bed, outside the form, and a corresponding projection at each end of the impression cylinder just equal in height to the thickness of the blankets. These bearers extended beyond the form in each direction, so that they received in advance the pressure of the impression cylinder which then ran smoothly over the form. This entirely remedied the defect and was at once applied to all the firm's cylinder presses. A patent for this device was granted to Mr. R. M. Hoe, April 17th, 1844, No. 3,551, and since its expiration, bearers have been adopted by all the printing machine makers in the country.

For the finer classes of printing, inks of a finer quality must, of course, be used, and such inks in an ordinary state are very viscid and tenacious, but when warmed, they become more liquid and easier to distribute in the press. In order to facilitate

the use of such inks, Mr. R. M. Hoe patented, April 17th, 1844, No. 3,550, a method of warming them by making the ink fountain roller and ink distributing rollers hollow and passing steam or warm water through them. This plan softened the inks and made them easy of distribution, but the method never came into general use, it being found, I believe, difficult to regulate the heat, and too much heat softens the composition rollers. Gas was then coming into general use and gas jets under the ink fountain were easy to manage.

The foundry in Gold Street was now found too small for the work required of it and it became necessary to have a larger one. Accordingly in 1844, a plot of ground 100 feet square, on the corner of Columbia and Broome Streets, adjoining the factory, was bought and the present foundry building 40 feet x 100 feet was erected on it. This was a great advantage in every way.

As the works had grown larger new tools had been added, but for the most part they were made in the factory and copied from the older ones, although somewhat improved. We had no standard of measure but our ordinary two feet pocket rules; gauges were comparatively unknown, and the various pieces of work were fitted one to the other. The screw threads were as they had been originally picked up, and the size of our taps and reamers were taken from the old ones or from our pocket rules. About this time the firm bought from Messrs. Joseph Whitworth & Co., England, three hand lathes with slide rests, a set of standard measure ring and plug gauges from ¼ inch to 2 inches diameter, a complete set of taps, hobs and screw cutting tools for hand use, and a bolt-cutting machine. This introduced into the works the Whitworth or English standard screw threads, which we are still using. There was also bought a fine bronze standard yard measure very accurately divided, made by Potter of London. These tools were a revelation to us, and made a vast change for the better in our manner of working. We began making gauges to standard measure for

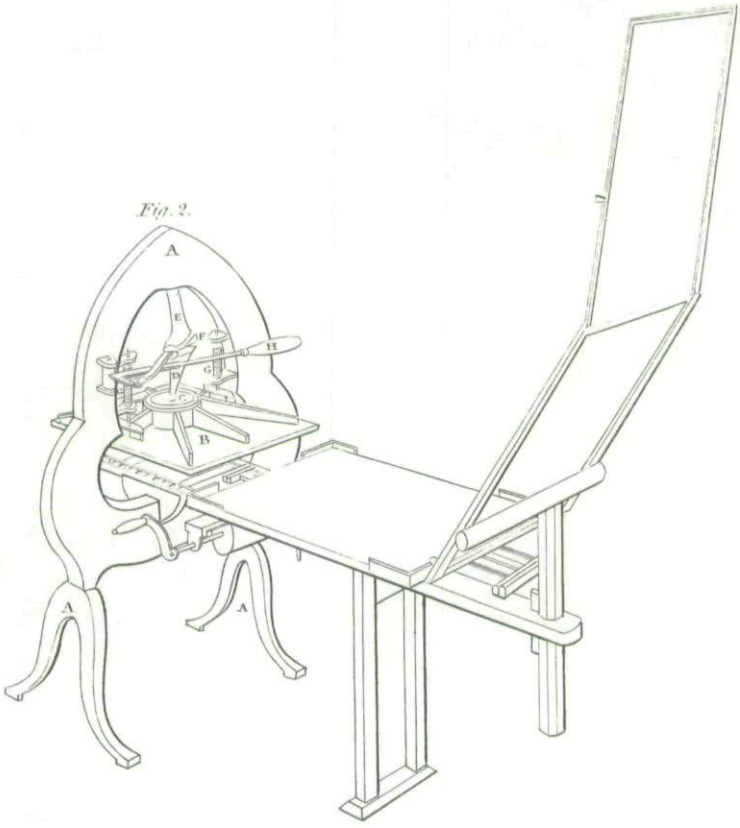
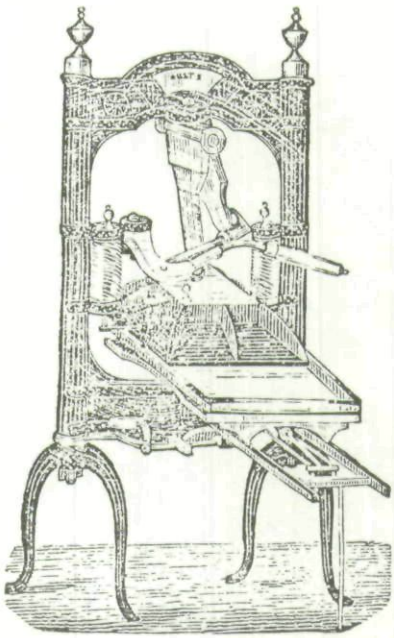


PLATE I.—Patent drawing of the Smith Press in *American Journal of Improvements in the Useful Arts*, I (1828).

WASHINGTON PRESS.



R. HOE & CO.

NEW-YORK,

Manufacture, and have generally on hand, every article necessary for a Printing Office and Bindery, and a variety of Machinery for other purposes.

PLATE II.—The Washington Press advertised by R. Hoe & Co. in C. S. Van Winkle, *The Printer's Guide* (New York, 1836).

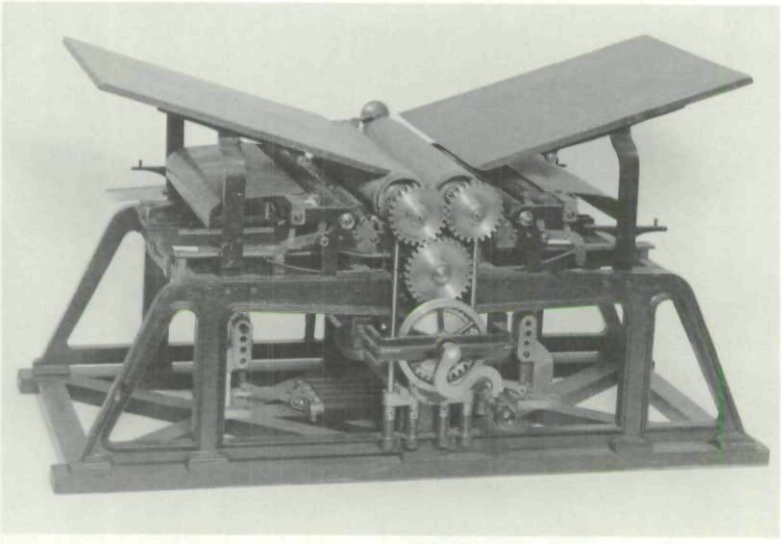
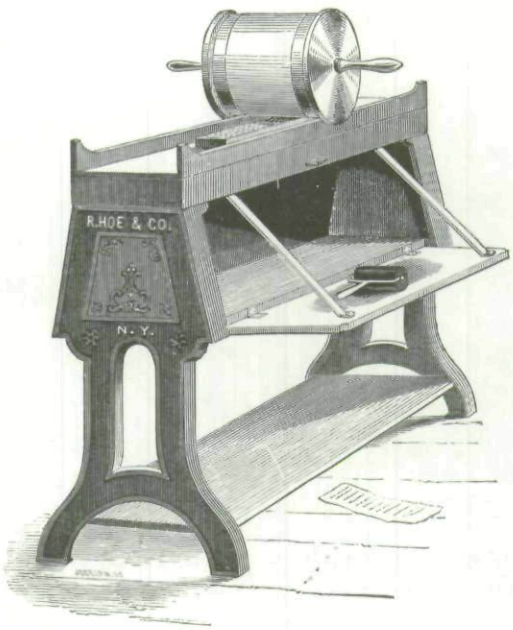


PLATE III.—Patent Office model of the 'Pony' Double Cylinder Press. (Courtesy of the Smithsonian Institution.)



R. Hoe & Co's Ready Proof Press.

THIS machine consists of a cast-iron table, or bed and railway, supported by a cast-iron frame. The solid cast-iron cylinder is of weight sufficient to give the requisite impression, and has a flange at each end to prevent it from running off the track; the surface of the cylinder is turned parallel to the bed, and is covered with a blanket. The railway stands above the level of the bed as much as the height of the type and the thickness of the galley bottom.

The frame is furnished with a closet to hold the ink-roller and damp paper, The closet door, when let down (as shown in the cut), can be used as a distributing table.

The machine should stand level, so that the cylinder will rest at either end. When a proof is wanted, place the galley with the matter in it on the bed, ink it, lay on the slip of paper and roll the cylinder to the other end of the railway.

PRICE, including proof roller, $65.00
Boxing and Carting,..... 2.50

PLATE IV.—R. Hoe & Co., *Catalogue*, 1860.

3 Sheets—Sheet 1.

R. M. HOE.

Printing Press.

No. 5,199.

Patented July 24, 1847.

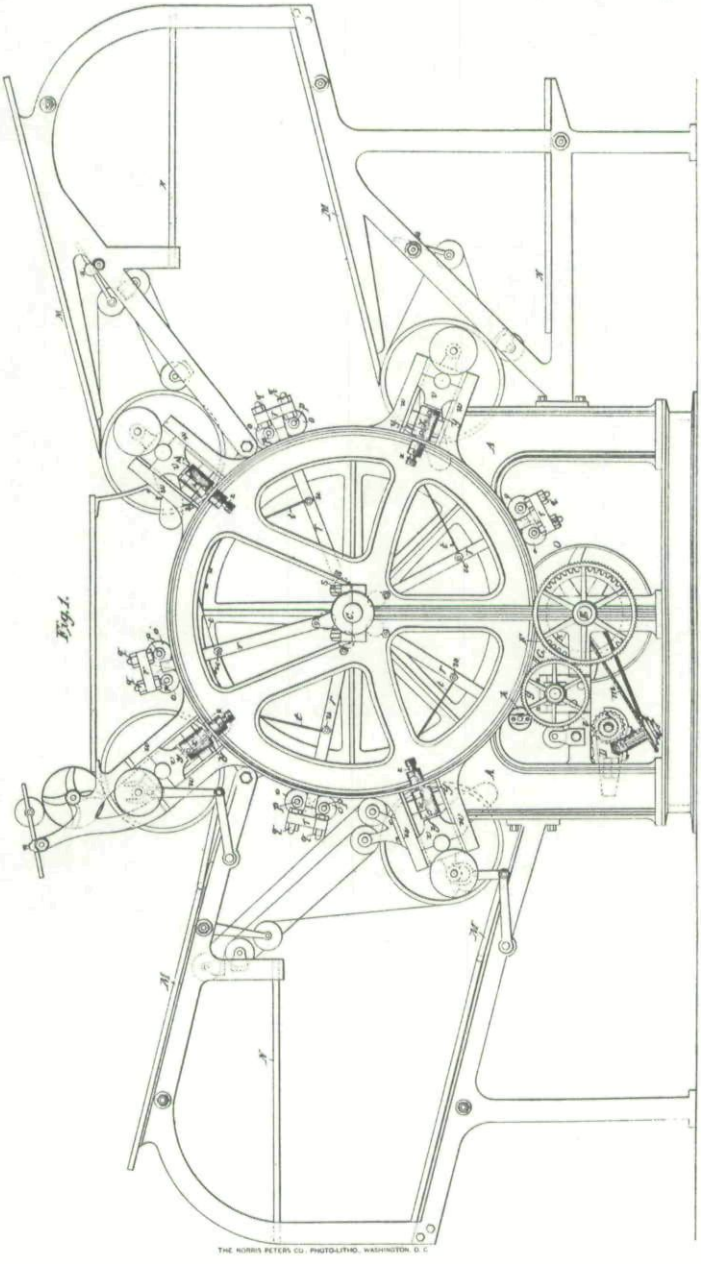


PLATE V.—Patent drawing of the Type-Revolving Press.

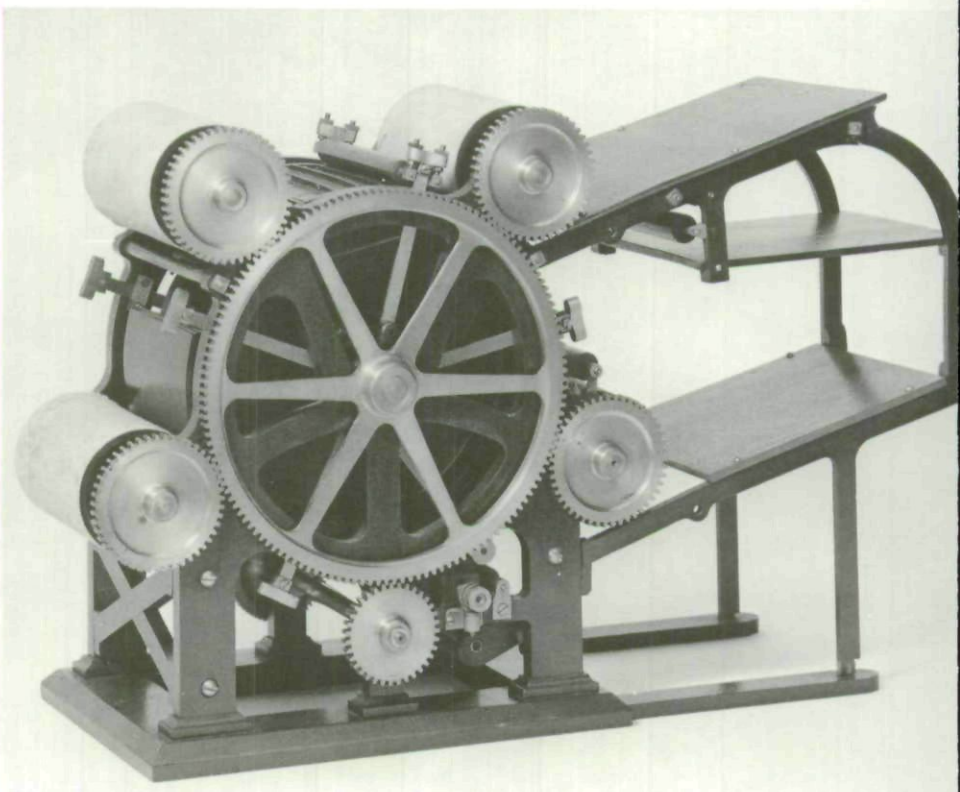
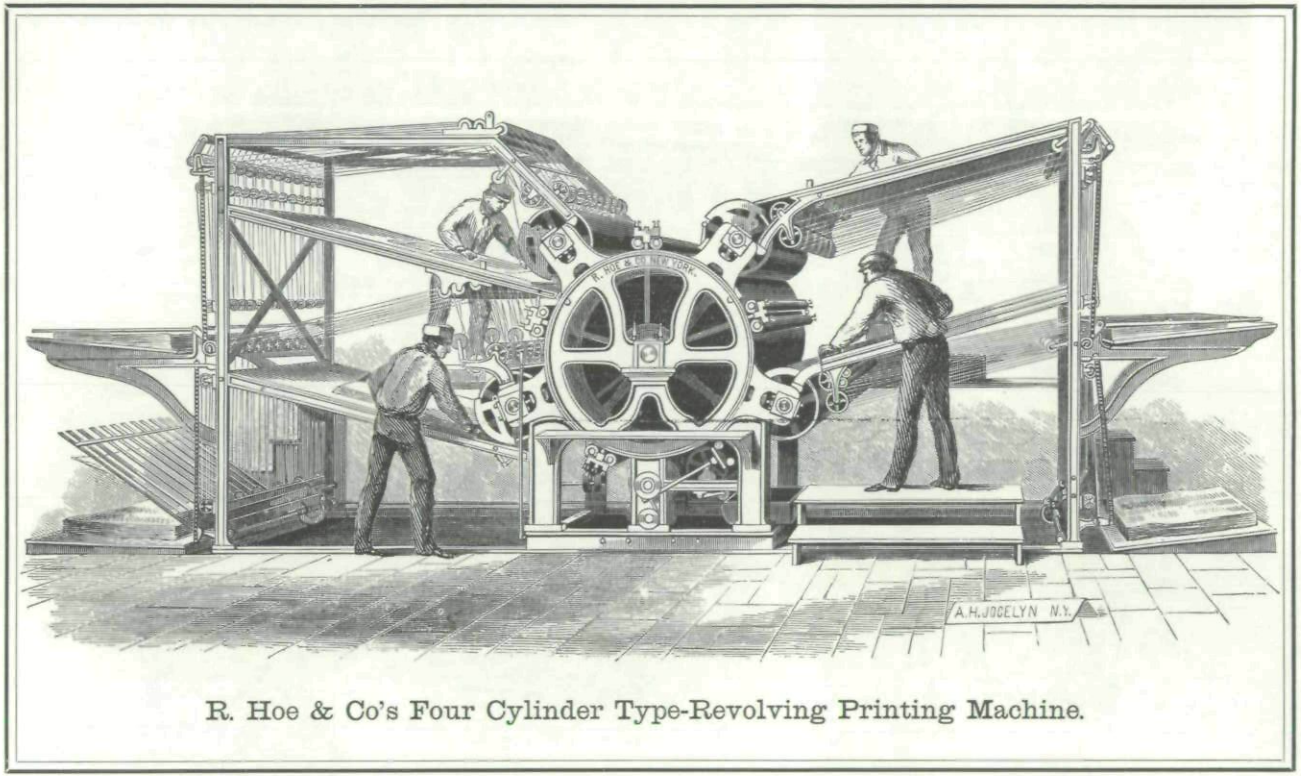


PLATE VI.—Patent Office model of the Type-Revolving Press.
(Courtesy of the Smithsonian Institution.)



R. Hoe & Co's Four Cylinder Type-Revolving Printing Machine.

PLATE VII.—R. Hoe & Co., *Catalogue*, 1860.

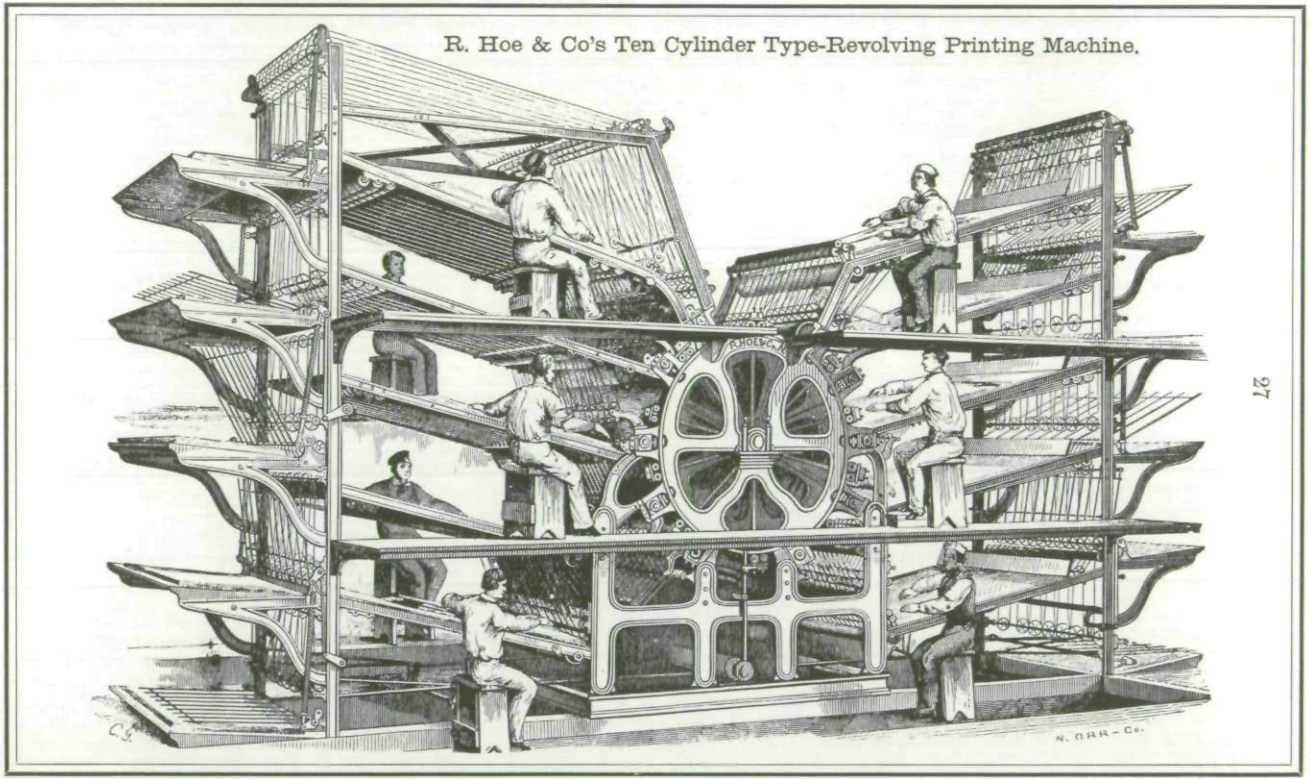


PLATE VIII.—R. Hoe & Co., *Catalogue*, 1860.

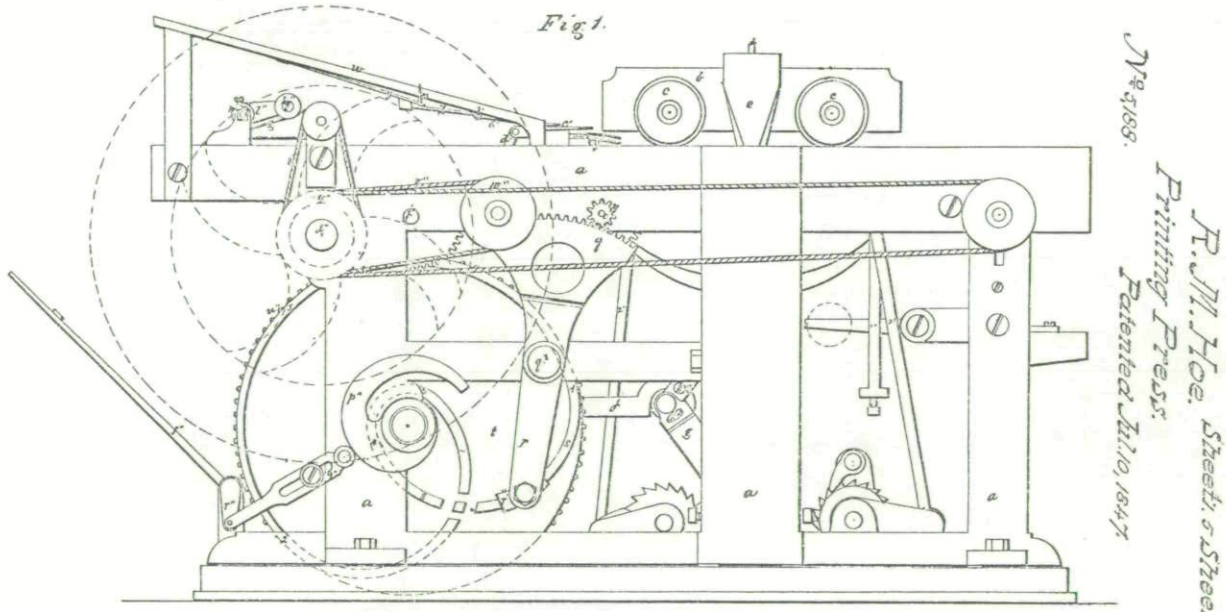
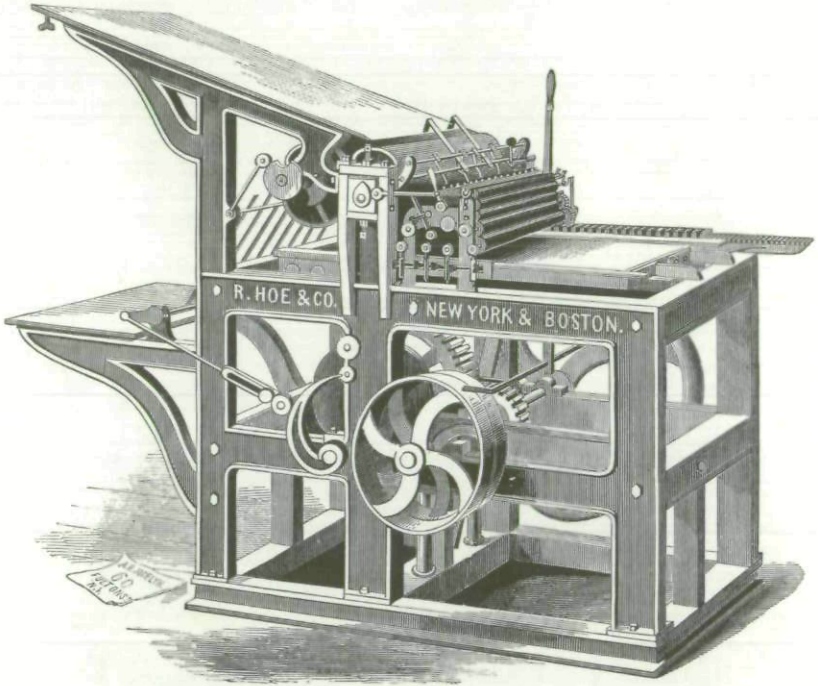
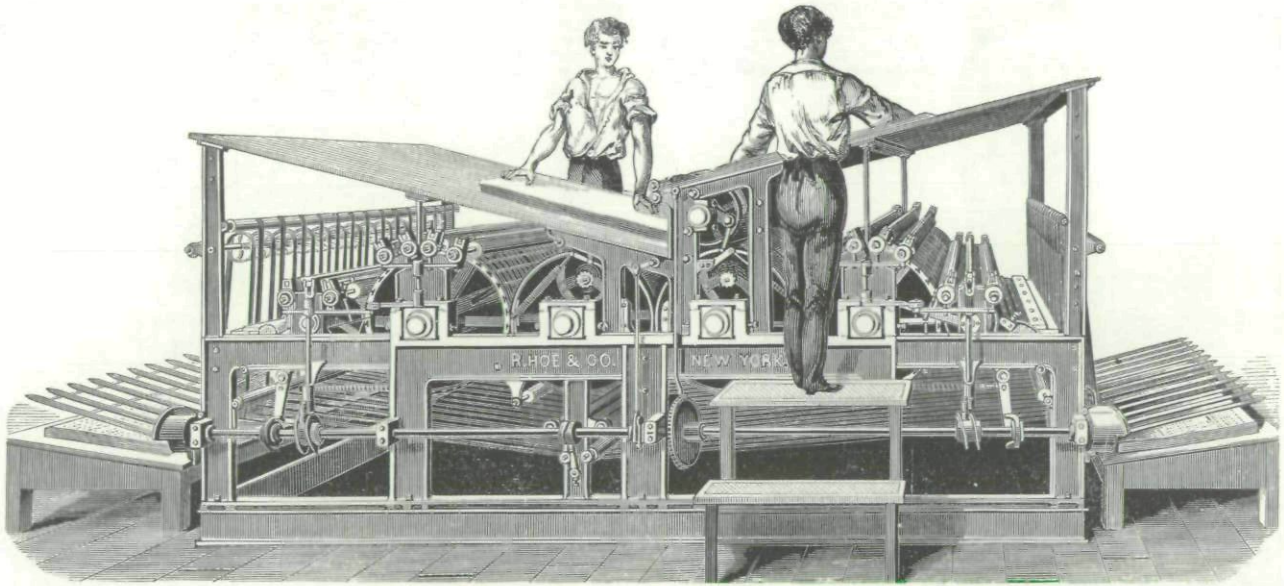


PLATE IX.—Patent drawing of a press similar to the Adams Press.



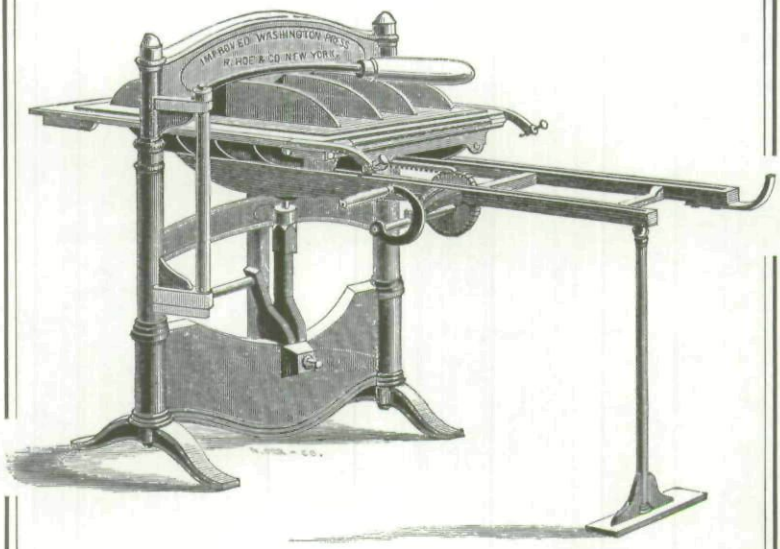
R. Hoe & Co's Four Roller Book Printing Machine.

PLATE X.—R. Hoe & Co., *Catalogue*, 1860.



APPLETON ROTARY BOOK PRESS

PLATE XI.—From Robert Hoe, *A Short History of The Printing Press* (New York, 1902).



R. Hoe & Co's Improved Washington Press.

THIS press in many respects is superior to the Washington as represented on preceding page. It takes up much less room in height and is equally simple, quick and powerful in its operation.

The sizes and prices are the same.

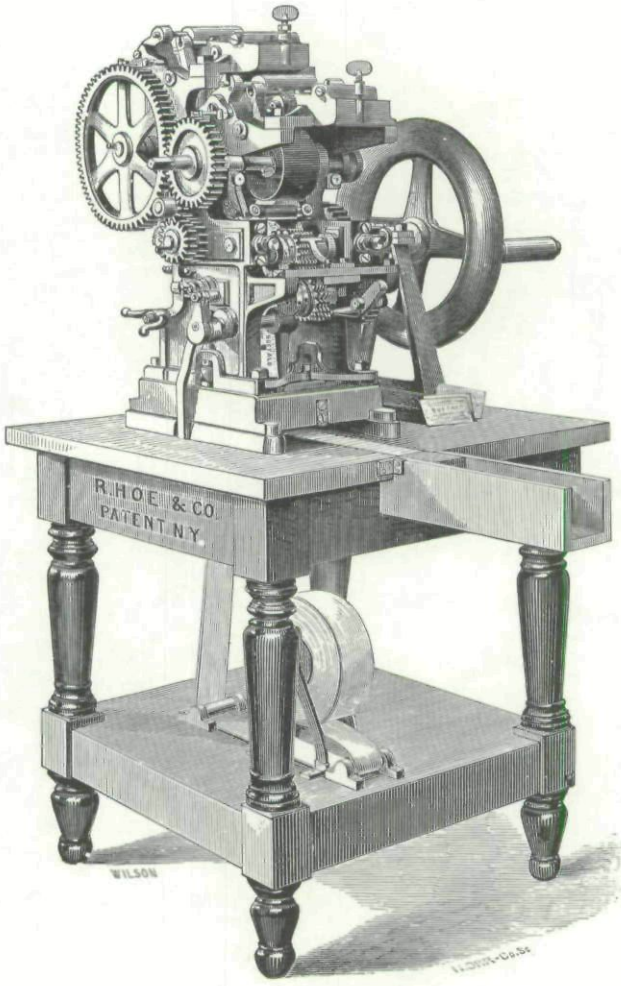
Directions for Putting Up the Improved Washington Hand Press.

First, put in the rods through the columns from below, then put the back slide piece through the cross brace between the columns. Next, put on the top or platen and secure the same with the nuts; observe to have the key holes in the bottom of the rods parallel with the frame, so as to admit of the legs being keyed on.

Next, put in the vertical shaft connected with the impression handles, then put on the feet or legs and drive in the keys to secure them. Stand the frame up and level it from the under side of platen, lay the ribs on fronting towards the name plate with the standard under the outer ends, and the standard and lever right under them on the frame with its adjusting wedge in its place, and connect the lever to the impression shaft.

Screw in the rack pinion, crank and shaft, also screw the rack to the underside of bed, lay the bed into the ribs, run it under the platen to its proper place, put a pair of bearers on the bed, and take an impression, and level up the outer standard to keep the ribs easy to work in their place.

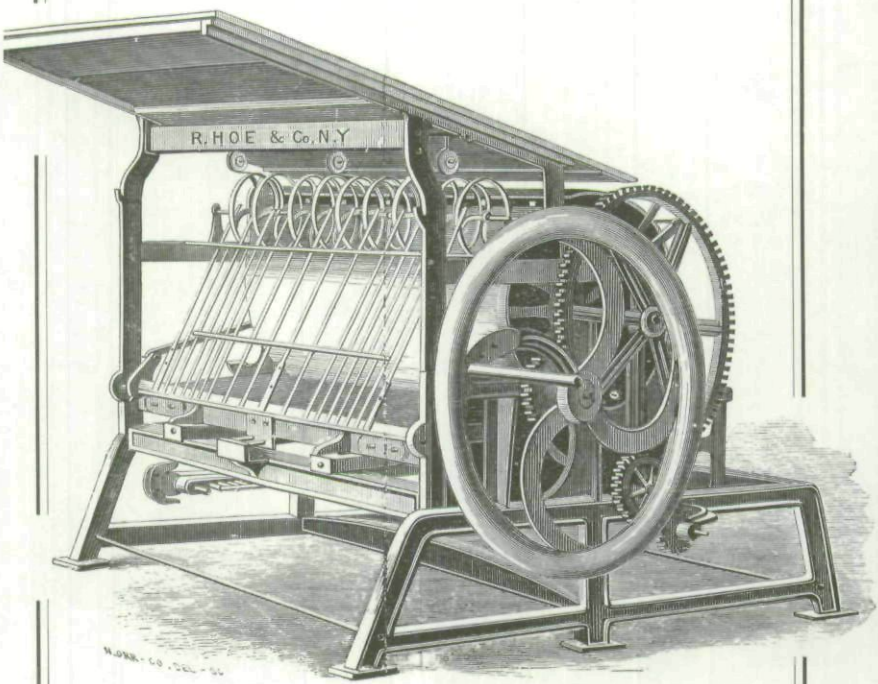
PLATE XII.—R. Hoe & Co., *Catalogue*, 1860.



R. Hoe & Co's Patent Railroad Ticket Machine.

In this machine the forms are placed on a cylinder which enables it to run with a continuous rotary movement. The tickets are worked from a roll of paper, and are printed, numbered, cut and deposited in a receptacle in numerical order in a single operation. The numbering apparatus prints the number in a different color from the body of the ticket, and can be set at 0 or any required number with great facility. The machine will print from 10,000 to 12,000 tickets per hour, and occupies a space of about two feet square.

PLATE XIII.—R. Hoe & Co., *Catalogue*, 1860.



R. HOE & CO'S

New Single LARGE Cylinder Hand-Printing Machine.

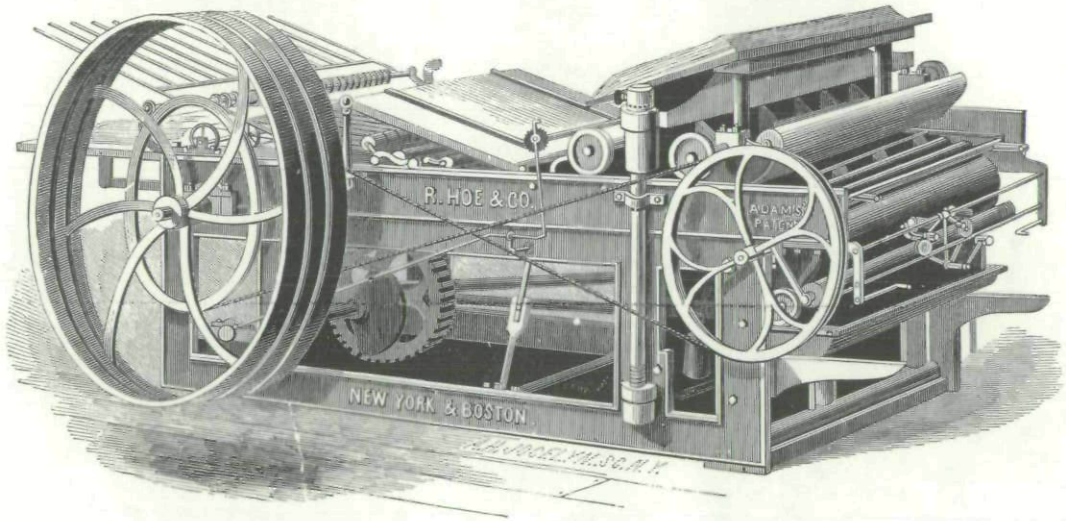
THE demand for a machine adapted to the wants of newspapers with small circulation has induced us to complete one to answer these requirements.

The above cut represents such a machine: it is intended to be driven by hand-power, and will print from six to eight hundred impressions per hour. It can be arranged, if required, to be driven also by steam-power. The speed can then be increased from one to two hundred impressions. It has registering apparatus, self-acting sheet-flyer, and iron bearers.

Size of Bed, inside bearers, 31 by 43 inches, price.....$1,000
If to be driven by Steam-power, extra.....$100
Boxing and Carting,.....$25

TERMS.—One-half cash, and one-half six months; or 2½ per cent. discount from the whole bill if all is paid in cash.

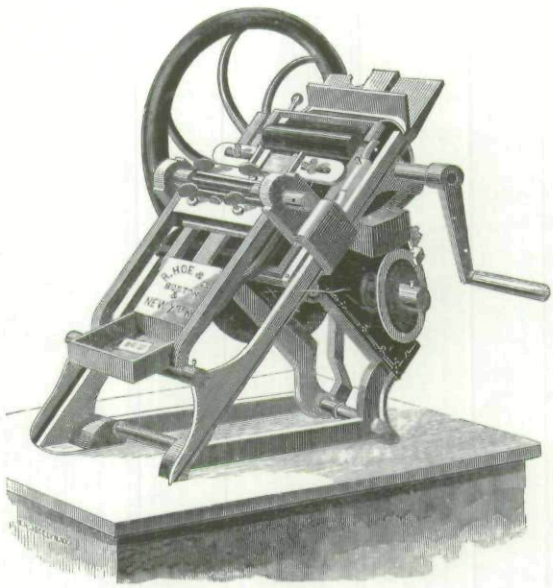
PLATE XIV.—R. Hoe & Co., *Catalogue*, 1860.



R. Hoe & Co's Bed and Platen Power Printing Machine. (Isaac Adams' Patent.)

(See pages 53 and 54.)

PLATE XV.—The Adams Press advertised in R. Hoe & Co., *Catalogue*, 1860.



Small Card Press.

In this Press the form is placed on an inclined bed, and receives ink from two rollers. The impression is given by a cam and may be regulated by platen screws. It has adjustable feed-guides, a large distributing cylinder, card rack and receiver, and is well adapted for long service. The removal of a bar, easily effected, allows the platen and guides to be thrown back and thus exposes at one glance bed, platen, guides and rollers, greatly assisting correction, making ready or cleaning-up. The movements are simple and the motion easy, enabling the operator to print from 1,000 to 2,000 per hour. Platen 4 × 5 inches.

A Roller Mould, two sets of Roller Stocks and three Chases are furnished with the press.

Price, $125.

Boxing and Carting, $3.50.

Driving Pulley, Fast and Loose Pulleys, Counter-shaft, Hangers and two Cone Pulleys, for steam power, extra, $50.

Terms of Payment—Cash at manufactories.

Plate XVI.—R. Hoe & Co., *Catalogue*, 1867.

the various parts of machines, so that when brought together there would be the least possible amount of fitting, thus doing more accurate work at less cost.

During 1844-5 some very expensive wood-screw machinery was built for Messrs. Pierson & Co., under the direction of General Harvey. We only made certain difficult parts, which were taken away and fitted into the machines elsewhere.

It is more than probable that our present sheet-flier was evolved from the tympan of the ordinary hand press; they are very similar in form, are both applied to laying down open sheets of paper, and both perform the operation in the same manner. Tympans were used on the old two-feeder Adams Press, which had two traveling friskets. A sheet was placed on a stationary tympan, and when the friskets came to a stop to print the sheet on one frisket, the sheet just printed was lifted off the other frisket, and a fresh one quickly laid on in its place by throwing over the tympan, thereby saving time. These tympans had no friskets, the sheets being held in place by the pressure of the atmosphere while being laid down, as with the present sheet-flier. When the improved Adams Press was brought out about 1836 this tympan was modified to receive the printed sheets and lay them down in a pile automatically, and worked very successfully on these slow running presses.[21]

Mr. R. M. Hoe was granted a patent, May 1, 1845, for adapting the automatic sheet-flier to fast running cylinder presses.[22] The arrangement operated so well in practice that the sheet-flier was immediately in great demand. We attached it to all new presses at once, as also to a great many old ones. In fact, it came into universal use, both at home and abroad and remains so at this time.

A cylinder ink grinding mill was built in 1845 for Mr. M.

[21] Isaac Adams was granted a patent for a 'Printing-press, Power' on October 4, 1830. Additional improvements were patented on March 2, 1836 and the patent was extended by Congress, August 16, 1856. (*Subject-Matter Index of Patents for Inventions*, Washington, D.C., 1874, III, 1920.)

[22] U.S. Patent No. 4,025.

P. Prout. It was composed of three cylinders about 10 inches diameter, running at different speeds and was very effective in grinding ink. We afterwards made several of these mills, but they were later on superseded in a measure by the celebrated 'Bogardus' mill.

In 1844-5 the firm built a rotary newspaper press designed to print from a stationary flat type form, (Patent No. 3,687, July 30, 1844).[23] A central horizontal shaft running in bearings in a pair of side frames carried two rings about seven feet in diameter, and around the circumference of these rings six impression cylinders, furnished with fingers, were mounted in sliding bearings. As the rings and the cylinders revolved in a circle, the cylinders also rotated on their axes, through being geared into a large stationary internal ring secured to one of the side frames. The form of type was placed horizontal, near the bottom of the circle, and formed a chord in the circular path of the cylinders, and the sliding bearings of these latter were guided by a stationary cam groove, fixed, one to each of the side frames, and of a shape that caused the cylinders to rotate in a straight line across the form. The inking rollers were attached to an endless chain, and received their ink from a fountain below the form, and traveled around over the form between the impression cylinders, and returned underneath. Around the main circle four feedboards were placed from which the cylinders grasped their sheets as they passed by, carried them around and printed them, and deposited them in a single pile. We had previously made a complete working model of this machine, one quarter size, and printed on it, and it ran smoothly at any speed we could turn it; and the full-sized machine worked smoothly at a low rate of speed but at the desired speed of 8,000 sheets per hour, the concussion caused by the cylinders in changing their motion from a circle to a straight line, and vice versa, was entirely too great for the safety of the machine. It was then suggested to make the path of the cyl-

[23] U.S. Patent issued to Richard M. Hoe.

inders a true circle, and to make the form of the type concave, but nothing further was ever done in the matter. Patented in Great Britain, October 3rd, 1844, No. 10,338.[24]

I happened in a composing room in Boston just at this time and saw a novel manner of taking proofs. Two bars of square iron about type high, were lying across an ordinary imposing stone and carried a small iron roller. A galley of matter, or a small form, was placed between the bars, the paper and a blanket were laid on and the roller passed over them and back. This seemed such a simple and quick way of taking proofs that the firm decided to bring out a proof press of this style in proper form. Accordingly a press was made having a cylinder covered with blanket, and an ink and paper closet beneath, and it was liked so well by the trade that several hundreds of them of various styles and sizes have been made (Plate IV).[25]

Early in 1846 I was made foreman of the hand press and miscellaneous department, but still retained charge of the experiment room in which we were then making a working model of a bed and platen power press.

In 1846 the firm introduced a steam inking machine for attaching to a hand press in place of hand rolling. It gave a perfect distribution to the best qualities of ink and was arranged with change wheels to roll the form with two rollers, from one to four times, and repeat if desired. It was designed for printing the very finest cut work, proofs, etc., and was in use for a number of years but with the continued improvements in machine presses, combined with speed, it finally dropped out of use. (R. M. Hoe's patent, July 31st, 1847.)[26]

[24] British Patent issued to William Newton (a communication). William Newton and William Edward Newton were independent Patent Agents who also obtained British patents for foreigners residing abroad. (Letter from Miss B. E. Parsons, The Patent Office, London, March 22, 1972.)

[25] Some of these proof presses were manufactured for a patent-medicine firm in Elkhart, Indiana. The firm gave them to country publishers in exchange for advertising space. 'They have "Dr. Miles" cast in raised letters at one end and "Nervine" similarly cast at the other end.' (James Eckman, *The Heritage of the Printer*, Philadelphia, 1965, p. 79.)

[26] U.S. Patent No. 5,212. See also Richard J. Wolfe, 'Richard M. Hoe's Power Inking Apparatus for Hand-Presses,' *Black Art*, II (1963), 40-45.

In June of this year Mr. Geo. F. Nesbitt ordered a lot of small brass ink fountains, the object being to print poster sheets and similar work, in several colors at one operation.[27] There were some twenty-five or thirty fountains for the various colored inks, ranging in width from ½ to 3 inches, and they were arranged to take the place of the regular fountain on a press. They were adjustable in the width of the press, so that they could be placed to correspond with the lines of type in the form, as desired. These fountains were attached to a cylinder press in Mr. Nesbitt's office, and the end vibration of the distributing rollers was reduced to prevent the different colors touching and blending together. But for some reason the plan does not seem to have been successful, and none were made for other parties.

In 1846 Mr. R. M. Hoe proposed to build a fast running newspaper press by the use of a form of ordinary type, having a convex surface given to it by making the column rules wedge-shaped and thickest at the top, and to put this form on the periphery of a revolving cylinder and place the impression cylinders, each with a feedboard, in fixed positions around its path. This seemed so feasible that we fitted up a type bed, filled it with type, put it on a cylinder about five feet in diameter and revolved it at one hundred revolutions per minute; and to the surprise of many, and gratification of all, the type showed no signs of flying off the type bed. This was so encouraging that a Four Cylinder Type-Revolving Press was at once built and early in 1847 was put in the office of the Philadelphia *Public Ledger* on trial (Plates V-VII).[28] The machines operated so satisfactorily, running up to a speed of 10,000 sheets per hour, that the *Ledger* immediately accepted it and ordered a second one.

[27] At that time George F. Nesbitt (1809-1869) possessed the largest job office in New York. (*Am. Dict. Printing and Bookmaking*, p. 389.)

[28] When the press was installed in the *Public Ledger* office, the March 17, 1847, issue of the *Dollar Newspaper* was printed on it as a trial. (*Dollar Newspaper*, March 17, 1847, p. 2.) The press was then used to print the *Public Ledger*, beginning with the issue of March 22, 1847. (*Public Ledger*, March 19, 1847, p. 2, March 22, 1847, p. 2.)

This at once demonstrated the value of the machine for fast newspaper printing, and it was followed by orders for presses from the New York *Sun*, *New York Herald*, *Boston Times*, and others.[29] (Mr. R. M. Hoe's patent, July 24th, 1847.)[30] The capacity of the machine was gradually increased by making them with 6, 8, and 10 impression cylinders, thus giving a production of over 20,000 sheets per hour (Plate VIII). It filled a long-felt want, and held its place until superseded a quarter of a century later by the modern web press.[31] Patented in Great Britain, May 4th, 1847, No. 11,688.[32]

Among other tools bought from Messrs. Whitworth & Co. was a lead-screw for a lathe. It was about 7 feet long, 2¾ inches diameter and ¼ inch pitch, and as it was said by Whitworth & Co. to be an exact pitch, we kept it as a master-screw

[29] 'The Boston Times has been compelled by its large circulation to procure "Hoe's fast press." There are only five of these presses yet in use, but they will soon engross all others. The first and second of them were used to print the Philadelphia Ledger, the third and fourth were made for the New York Sun. The fifth is that now in possession of the Boston Times. The sixth and seventh are being made and nearly completed, to be put up in the office of the New York Herald, and the eighth and ninth are ordered for Paris.' (*Scientific American*, III (1847-48), 229.)

[30] U.S. Patent No. 5,199.

[31] In 1856 the New York Correspondent of the *Manchester Guardian* reported the success of this press: 'The largest presses ever built are the eight cylinders, which will throw off 20,000 sheets an hour, or 333 copies per minute! These presses cost 25,000 dollars each. There are but three in existence. The first pair were built for the *Philadelphia Ledger*, a paper which circulates 80,000 daily, or more than any other daily journal in the United States. The proprietors were forced to build these fast presses in order to meet the enormous demand for their paper. Soon afterwards the *New York Sun* ordered one, which it uses in connection with a four cylinder one, and by which means it can strike off 30,000 copies every hour. The *Herald*, of this city, uses two four and one six cylinder presses, which enables it to print hourly 40,000 papers. The *Times* and *Tribune* have each a four and six cylinder; the *Commercial Advertiser* and *Post* a four cylinder; the *Boston Journal* one six cylinder; *Traveller*, *Times*, and *Transcript*, also of Boston, one four cylinder each; the *Baltimore Sun* two four cylinders, and the *Cincinnati Commercial* one. The Messrs. Hoe are also building a four cylinder for the *Boston Herald*, and another for the *Philadelphia Sunday Despatch*. The four cylinder press will run off 10,000 sheets an hour, and costs 12,500 dollars; the six cylinder, 15,000 sheets, and costs 18,000 dollars; and the eight cylinder, 20,000 sheets, and costs 25,000 dollars.' (Quoted in *Typographical Circular*, New Ser., XXVIII (1856), 233.) The cost of the eight cylinder press made for the New York *Sun* in 1849 was about $20,000.00 (*Scientific American*, V (1849-50,) 68.) To celebrate its installation, the proprietors of the *Sun* tendered a dinner to Col. R. M. Hoe on January 29, 1851. (*Scientific American*, VI (1850-51), 173.) A description of the *Sun* press is in *Scientific American*, VI (1850-51), 283.

[32] British Patent issued to William Newton (a communication).

for cutting other lead-screws. Having occasion about this time to use it for that purpose it occurred to me to have it compared with our bronze yard standard made by Potter of London, when to my surprise we found the screw to be just 1/20 of an inch too short in 6 feet of length. To overcome this defect in the new screw to be cut, I decided to draw the Whitworth screws endways 1/20 of an inch while making 144 revolutions and carrying the tool-carriage 6 feet in length. To effect this a 1 ½ inch hole was drilled in the driving end of that screw and threaded 20 threads per inch, and one end of a short screw was similarly threaded and fitted into this hole in the screw to draw it endways. This drawing screw worked in a bracket bolted to the lathe bed and had a collar on its outer end and a driving wheel keyed on it inside of the bracket, while the threaded end entered the hole in the lead-screw. The driving wheel on the end of the lead-screw had 145 teeth while the one on the drawing screw had only 144 teeth, but both wheels were the same diameter, and being side by side, were both driven by one broad-faced wheel. Thus for each revolution of the lead-screw the drawing-screw wheel made one revolution, plus one tooth, and when the lead-screw had made 144 revolutions the drawing screw wheel had gained just one revolution and drawn the lead-screw and its tool carriage endways 1/20 of an inch. The master-screw cut in this manner was as near an exact pitch as we could measure with our bronze standard, and although I did not consider it a thoroughly accurate screw, yet it was probably the best one in the country for many years until the making of screws of precision became a specialty.

The firm made in 1846 a large sized fan blower for Peter Cooper's Iron Works. Likewise a very powerful fly-press for the Harlem River Railroad Co., and one for the New Jersey Railroad Co. These were used for punching holes in rails, etc.

During 1846-7 Messrs. R. Hoe & Co. built a Bed and platen power press; (Patent No. 5,188, July 10th, 1847) designed for book and cut printing, similar to the Adams Press, and it was

put into operation in the Bible House, then located in Nassau Street (Plate IX).[33] After this machine had been running successfully for some considerable time, Mr. Isaac Adams claimed that it was an infringement of his patent. He also then claimed that the use of the sheet-flier on cylinder presses infringed his patent, although he had never objected to it during the previous years that it had been in operation. After years of dispute and negotiation the ultimate result of the matter was that Messrs. R. Hoe & Co. in 1859 bought Mr. Adams' patent rights, drawings, patterns, stock and tools; in fact, his whole interest in printing machinery, and added it to their business.[34]

It is well known that when one shaft drives another at an angle through a universal joint, the driven shaft does not revolve with a perfectly uniform motion, and this defect is sometimes observable on the sheets printed from a form on a type bed driven in this manner, more or less, according to the angle of the shafts with each other. In machines which print while the type bed runs in one direction only this defect can be obviated by having the universal joint shafts nearly or quite in line with each other when printing, the irregular motion caused by the greater angle of the shafts during the return run of the bed being of no consequence, but in Double Cylinder and other machines in which the bed prints running in both directions this plan is not practicable. A patent was granted to Mr. R. M. Hoe, July 24th, 1847, for a device for driving a type bed without a universal joint.[35] As shown in the patent, the driving shaft carries a wheel on its inner end which gears alternately into two racks secured to the type bed, one rack above and one below the wheel, and one rack is placed the breadth of the wheel out of vertical line with the other. When the wheel is geared with one of the racks and arrives at its end, it connects with a stud in a vibrating lever, and a fixed half circle, which

[33] U.S. Patent issued to Richard M. Hoe.

[34] The official announcements of this purchase are in *The Printer*, II (1859-60), 4.

[35] U.S. Patent No. 5,200.

serve to stop the bed slowly and start it in the opposite direction, and while that is being done the shaft is shifted endways and its wheel then gears into the other rack and continues the motion of the bed to the end of the rack, when it is stopped and started in the opposite direction as before. This was applied to a press in the factory and worked at a slow speed, but the device for stopping and starting the bed could not be made sufficiently rigid to work smoothly at high speed, and the plan was abandoned.

In 1847 we built for Mr. Henry G. Thompson a model of an iron bridge, about twenty feet long. It was composed of lattice work and when tested was said to be stiffer and stronger than any bridge of the same weight of material heretofore made.

There was made for Mr. J. J. Haley, under the direction of Mr. Duncan Turner, a machine for twisting telegraph wires into a cord or cable.

The firm also made for the United States Government a cannon from crucible steel made by Saltus & Co. of Staten Island. It was made under the direction of an ordnance officer of the army. It was about three inches bore, and I understood it was to be tested in competition with a brass cannon as to its qualities for light or field artillery.

In 1847 there were made for the United States Government, under the direction of Mr. Gilbert Smith, four cast steel rifles of large caliber, stocked in the ordinary manner and mounted on tripods. They were about one inch bore and were intended for sharpshooters, but in practice were found to be too cumbersome.

During this year the firm made a model of a steamship for Capt. E. K. Collins, to determine the relative efficiency of paddle wheels and screw for propelling a vessel. The boat was about six feet long and the machinery was driven by strong flat coiled springs. We had many trials in a little lake in the upper part of the city, with paddle wheels and screws of differ-

ent forms and sizes, and changing from wheels to screw and vice versa, with the same driving power. But the paddle wheels invariably beat the screw, and the result of these trials was that when the Collins Line of Steamships were built they were propelled by paddle wheels.

A small working model of a rotary steam engine was made for Mr. Henry G. Thompson and it operated so well that he ordered a working engine of ten horsepower to be built. The engine was composed of a revolving drum or cylinder about 20 inches diameter and 16 inches long, mounted on a shaft, and had its periphery formed into four curved longitudinal projections of a desired form. This revolved in a close fitting case, whose circumference was fitted at three equidistant points with sliding gates which worked in lateral grooves through the case, with their inner ends resting on the revolving cylinder. The outer ends of the gates were secured to cross-heads that had connecting rods on their ends which were jointed to cranks on pinions that were driven by wheels secured to each end of the cylinder shaft, and by these means the ends of the gates were always kept in positive contact with the curved periphery of the cylinder. There were steam openings to the cylinder through one end of the case at one side of the gates and similar openings at the other end of the case at the opposite side of the gates, and these openings operated at times as both steam and exhaust passages. When steam was admitted at one end of the case it pressed in opposite directions against the gates and the projections on the cylinder forced the yielding cylinder to revolve and then escaped through the openings at the opposite end of the case; and when steam was admitted at the opposite end it also revolved the cylinder, but in the opposite direction. The admission and escape of the steam was controlled by the projections on the cylinder as they passed in front of the openings, thus there were no valves. This engine operated so well that it attracted a great deal of attention and great expectations were entertained by certain parties that it would entirely super-

sede the ordinary reciprocating engine. Shortly after, in 1848, Mr. Thompson contracted with the West Point Foundry to have an engine built with a cylinder 15 feet in diameter, to be put in a boat to run between New York and Albany. The engine was commenced but it was reported that Mr. Thompson's financial arrangements failed and the whole project went to pieces.

In 1848 the firm made a set of six steam cooking kettles for the Nursery on Randall's Island; also a set of ten for the Marine Hospital at Staten Island, together with a boiler to furnish steam. All the boiling, roasting, &c., of food for these institutions were done in these kettles and they were found to be very convenient and economical. Afterwards, several sets were made for other public institutions.

A machine for sawing shingles was made for Mr. J. C. Fremont, which sawed the shingles, point and butt alternately, automatically, and was very satisfactory.

There was also made two iron ruling machines for Mr. Geo. F. Cooledge, to rule both sides of the sheet at one operation. They were said to be something new, and to work successfully.

Mr. R. M. Hoe obtained a British patent, July 18th, 1848, No. 12,216, for improvements in Type-revolving presses, Hand presses, Self-inking machines and Steam inking machines.[36]

During a visit of Mr. R. M. Hoe to Europe in 1848 he obtained from the proprietor of the Paris newspaper *La Patrie* an order for a Four Cylinder Type-Revolving Press. Then he returned to Paris with the press in the autumn of 1848. I accompanied him to erect the machine and put it in operation. This was accomplished after some delay; but the feeders, who had been accustomed to French machines which only ran from ten to twelve hundred sheets per hour, could not be made to believe that it was possible to feed at the rate of two thousand

[36]British Patent issued to William Edward Newton (a communication).

per hour, and it was not until we promised them a bonus of 200 francs each that we finally got them up to the required speed. The machine then ran so successfully that the proprietor of *La Patrie* gave an order for a six cylinder press, and it was arranged that I was to remain and make the drawings and superintend the building of the machine. But the stamp duty of one sou per copy, which had been taken off at the Revolution of 1848, was restored after Louis Napoleon's election as President in 1848. This at once cut down the circulation of the one cent papers to such an extent that the six cylinder press being built was no longer needed, and it was countermanded. This led to a law suit which kept me in France for another year, and which resulted in *La Patrie* being condemned to pay the firm a good round sum as damages.

It was reported to Messrs. R. Hoe & Co., during 1847, that the London *Times* was making inquiries here about the Type-Revolving Press. But apparently Mr. Applegath, the mechanical engineer of the *Times*, and who had built their flat-bed presses, did not approve of the mechanical arrangement of our machine, for he proceeded to construct a Type-revolving machine for the *Times* on the same principle as ours, but in which he placed the type and impression cylinders vertically. The surface of the type beds instead of being a true curve were formed with a series of flats to agree with the width of the columns of type, and the surfaces of the impression cylinders were made with a series of longitudinal projections to correspond. In a description of the machine published in the London *Times*, December, 1848, it is stated as a reason for placing the cylinders in a vertical position, that 'no art of packing could make the type adhere to a cylinder revolving round a horizontal axis and therefore aggravating centrifugal impulse by the intrinsic weight of the metal.'[37] At that time there were a half dozen of our machines in successful operation.

[37] *The Times*, December 29, 1848, p. 4.

In 1849 Mr. R. M. Hoe filed a caveat for a method of printing one or more rolls or webs of paper on a Type-revolving press, cutting the webs into sheets and flying them. As described, the central type cylinder of the press carries at opposite points of its periphery the outside and inside forms respectively of, say, a newspaper, and around this are placed four impression cylinders, two at each side. As a form approaches the two cylinders at one side the paper for them is drawn from their rolls by drawing rollers, is printed by the form and then stops until the opposite form approaches when it is again drawn forward, printed and stops, and so on until the paper is entirely printed on one side and rewound into rolls. These cylinders are then supplied with fresh rolls, while the partially printed rolls have their blank sides printed in like manner by the two opposite impression cylinders, and these two perfected webs are then brought together properly and cut into sheets by shears and flown. The caveat also shows printing a web applied to a flat-bed cylinder press and a bed and platen press. Now, the time occupied in taking an impression on an ordinary sized sheet on a type-revolving press running at a moderate speed is less than one-half second, and it was the general opinion that neither the mechanism drawing the paper, nor the paper itself, could stand the strain of starting from a state of rest and draw the paper forward 3½ or 4 feet and stop suddenly, in one half of a second. Nothing further was done in the matter, but the caveat was kept alive several years although never patented.

As the firm did not now occupy the whole of the Gold Street works, the remainder was let out to tenants. Early in 1849 a fire broke out in the premises of one of these tenants, which totally destroyed the building on the street, and partially destroyed the one connecting with the rear building. They were, however, immediately built in a more convenient form than before.

The California gold fever was beginning to rage at this time, and the firm made a gold washing machine for Mr.

William Clark; likewise a gold separating machine for Messrs. Ambler & Drake.

We also made a very powerful hydraulic press for Mr. Selah Hyler for pressing stair rods and similar work.

The increase of work caused largely by the introduction of the Type-Revolving Press, made it necessary to have more room for the machine shop, so in 1850 a building 34 feet x 60 feet, four stories high, was erected on Columbia Street, adjoining the foundry, for the carpenters, pattern makers, pattern storage, &c., and a fifteen horsepower engine and boiler were placed in the basement for driving the machinery. The experiment room was moved into an upper story of this building, and the two upper stories of the factory previously occupied for wood work were added to the machine shop.

In 1850-1 there was made in the experiment room a part of a type-revolving press consisting of an impression cylinder with feedboard and delivery apparatus, full size. A sheet from the feedboard was taken by the impression cylinder and was supposed to be presented to a form on the type cylinder, by which its first side was printed. The sheet then ran into delivery tapes, and in the operation of printing and delivery it was naturally turned upside down. The motion of the delivery tapes was then reversed and the sheet was returned back to the cylinder, rear end first, which took it, and presented its unprinted side to a second form on the type cylinder, after which it was delivered and flown in the usual manner. It was the intention to cut the sheets from a roll automatically, (thus dispensing with feed-boys) as well as to perfect the sheets, but the reversing device did not work smoothly at the desired speed of 2,000 per hour, and the apparatus was laid aside, and, although patented by Mr. R. M. Hoe, July 26, 1859, it was never brought into use.[38]

The firm had, from time to time, bought more tools from Messrs. Whitworth & Co., hand and slide lathes, surface

[38]U.S. Patent No. 24,875.

plates, a slotting machine, a shaping machine, a drilling machine, and, latterly, a wheel-cutting machine with self-feeding and tripping motions; this last machine more particularly for cutting the large wheels of the type-revolving presses.

About this time Mr. A. M. Freeland, who had previously been a foreman in the Novelty Iron Works and who had lately visited England, to see the latest improvements in machinist's tools, started the making of machine tools in this city. Three slide lathes were bought from him in 1850 and they were found so much more convenient and better than any in the works from Whitworth & Co., or any other maker, that the firm then bought their lathes, planers, slotters, wheel-cutters, etc., almost exclusively from him until his death in 1870.

It had always been the practice in the factory to keep the small tools, taps, reamers, drills, &c., in open racks in care of no one. The men took them from the racks, if they were there, and were supposed to return them, but very often did not. If not there, an hour or more might be spent in hunting up a tool wanted. If worn out or broken, the tool would of course be returned in that condition if possible, leaving it for the next man who required to use it to put it in order. If a man broke a drill, for instance, before he had finished using it, he took it to the blacksmith shop and waited there until it was dressed, and so with all other tools. I had observed while abroad in 1849-50 that the best workshops were provided with tool rooms, in which all small tools were made, repaired, given out and kept in charge, and after my return in 1851, I wished to have one in my department, which, after some objection on the score of expense, was agreed to. All tools were brought into the tool room, and the rule made that no man should make or repair a tool; all were to be gotten from, and returned to, the tool room. The great convenience and economy of this arrangement were quickly apparent and it was quickly adopted in the other departments.

While abroad I visited many printing offices, and saw in an

office in Paris a press made by Dutartre, with which I was much pleased. It was a Stop Cylinder Press, the first I had ever seen, and it seemed to me that the plan of having the cylinder, while stationary, seize the sheet, and then to gear direct into a rack on the side of the type bed, must make perfect register.[39] The bed was driven direct by a crank, and this required a crank arm so long that in order to keep the press low the crank ran partly in a pit in the floor. This was objectionable, but I thought it might be avoided. I mentioned this machine after my return, and the firm decided to build a small one for job work. In 1851 we made drawings and built a press, form 9 x 12 inches. The type bed was driven by a crank through the intervention of a slotted lever, which permitted a short crank arm. A rack on one side of the bed geared into a wheel on an impression cylinder fitted with fingers, and whose circumference was equal to the travel of the bed, thus the forward run of the bed turned the cylinder just one revolution. The teeth of the wheel were cut away at this point and a catch lever, operated by a cam, caused this lever to catch and stop the cylinder until the bed ran back, and then start it forward for the rack to again gear with the cylinder and carry it around. A delivery cylinder having fingers to grasp the sheet was geared to the impression cylinder, which thus required no tapes around it, and the fingers on these cylinders never required shifting, whatever the size of the sheet printed. This made the press very convenient for job work. A sheet was fed to the cylinder while stationary, carried forward by its revolution and printed and taken by the delivery cylinder. At the next revolution of the cylinder this sheet was delivered to the sheet-flier and a fresh sheet was printed and so on. The press would run 3,500 to 4,000 sheets per hour, and was nicknamed the 'Little Astonisher.'

This press worked so well that the firm decided to make a

[39] This press had been devised and patented in France by Dutartre in 1852. (Robert Hoe, *A Short History of The Printing Press*, New York, 1902, p. 22.)

larger size, so in 1852 a 'Medium' size was built. The method of driving the bed through a slotted lever allowed a short crank, so that no part ran below the floor; the four form rollers produced excellent work, the stationary cylinders while taking the sheet gave perfect register, the absence of tapes on the impression cylinder and no shifting of fingers were a great convenience. Hence the machine soon became popular, the only objection being that it stood rather high, and this gave it the name of the 'High Stop Cylinder' (Plate X).

In 1852-3 Messrs. R. Hoe & Co. built two Rotary Perfecting Presses, with the forms on large cylinders instead of on a flat bed. One of these was for printing *Thompson's Bank Note and Commercial Reporter*, from type, and after a few years' service it was destroyed by fire. The other one was for Mr. Geo. F. Cooledge, for printing a 'Spelling Book' from electrotype plates, and superseded the Flat Bed Perfecting Press we built in 1844.[40] The sheets were transferred from the first impression cylinder to the second as usual. The electroplates were made and finished flat and then bent to the curve and mounted on movable metal blocks that were made up into a form precisely the same as we are now doing. This machine is still running and doing good service in the office of Messrs. D. Appleton & Co., Brooklyn (Plate XI).

In 1853, before the days of papier-mâché matrices and quick stereotyping, it seemed that the only way to print a daily newspaper on a web of paper by cylinders was to put the type on cylinders, and previous attempts by Messrs. Hill, Wilkinson and others, showed that this was a difficult thing to do. Mr. R. M. Hoe thought that if both outside and inside forms were put on a cylinder at the same time its diameter would be

[40]The firm of George F. Cooledge and Brother, New York, was the authorized publisher of Noah Webster's *Elementary Spelling Book*. (*A Bibliography of the Writings of Noah Webster*, comp. Emily E. F. Skeel, ed. E. H. Carpenter, Jr., New York, 1958, p. 128.) 'These presses were especially designed for printing books, of which large numbers were required, such as text books and spelling books. The contents of a whole book could be placed on these cylinders and printed and delivered at one impression.' (Hoe, *A Short History*, p. 66.)

doubled, and on that account it would be more convenient to put the type on, and also, its increased diameter would give space around it to print two or more webs on it at once. But this plan required the web to be turned over after its first side was printed, to have its second side presented to the same cylinder. This we tried to do by running the web over rollers, straight and barrel shaped, placed at all angles, and at various distances apart, but without success. The path of the edges of the web was longer than the path at the center so that the edges were strained and tore. We tried running the web over these rollers between an upper and lower web of cloth, but the paper web would still tear at the edges, and the plan was finally dropped.

At this time letter envelopes with printed stamps were coming into use and during this year three small presses specially designed for printing stamps on envelopes were built for Mr. Geo. F. Nesbitt, who had a contract with the Government for this work.[41]

A plan was now devised by Mr. Wm. L. Colby for driving the type bed of cylinder presses without a universal joint by means of two pairs of bevel wheels and pinions. These were placed at one side of the press, outside of the frame, with the pinion shaft running lengthways of the machine. One pinion and wheel drove the impression cylinder and the other drove a shaft that carried the double rack pinion on its inner end. The outer end of this shaft ran in a yoke that hung loosely on the bevel pinion shaft, and in this manner the bevel wheel and pinion were kept properly in gear as the inner end of the shaft rose and fell in the operation of driving the bed through the double rack. Quite a number of double cylinder presses were made with this arrangement, but it was never patented. They worked properly but the bevel wheels were somewhat noisy

[41] 'The attempt in England to make a combined stamp and envelope up to that time had failed, but Mr. Nesbitt was able to succeed.' (*Am. Dict. Printing and Bookmaking*, p. 389.)

and there was considerable play in the teeth of so much gearing that was objectionable, and the device was finally superseded by the hollow shaft now in use. Nearly or quite all the machines built with this device were afterwards altered to the hollow shaft.

Just about this time the firm bought Mr. Victor Beaumont's patent, dated September 6th, 1853, for a method for printing a continuously moving web of paper on a Type-Revolving Press, cutting it into sheets and flying the sheets.[42] This patent shows a plan for printing one side of a web complete from a form which occupies only one-third of the circumference of the type cylinder by means of three impression cylinders placed near together with registering rollers behind them, around all of which the web passes in such a manner that one-third of it is printed by each impression cylinder. Both the outside and inside forms are placed on the type cylinder close together, so that the impressions on the web are from the outside and inside forms alternately, and as the first side is printed, it is laid down back and forth, or zig-zag in a pile. The web is then passed through another set of three impression cylinders below the first set, by which its second side is printed from the same forms, and it is so timed that the outside and inside impressions on its first side shall now be backed by the inside and outside forms respectively. The web then passes between a pair of cutting cylinders, one of which carries a serrated blade which cuts it into sheets, and these are conducted by tape to an oscillating sheet-flier which lays them on inclined tables to the right and left alternately. The drawings show a second web being printed from the same forms by two other sets of impression cylinders of three each, on the opposite side of the machine. If the form occupies only one-fourth of the circumference of the type cylinder then four impression cylinders in a set are necessary, and if it occupies one-half of the circumference then only two impression cylinders in a set are required.

[42] U.S. Patent No. 9,987, issued to Victor Beaumont, New York, N.Y.

This method of printing a web is very ingenious and is precisely the same as the web is printed on the firm's present Type web presses. But the scheme as a whole did not seem very practicable and the patent was probably bought to keep it out of the market.

In 1854 the firm made a hydraulic testing press for Mr. R. G. Hatfield, an architect. The cylinder was 4 inches bore, and the press was furnished with the necessary fixtures for holding the materials tested to ascertain their lateral, tensile and crushing strengths. A small sliding hydraulic piston was connected with the pendulum lever having a pointing arm, which indicated on a graduated scale the pressure sustained. The tests of the strength, &c., of the various metals given in Mr. Hatfield's work on 'House Carpentry' were made with this press.[43]

A small rolling mill and punching press were made for a Mr. A. G. Paine. These were for rolling strips of silver, punching out the blank pieces and stamping or coining them. The frames of these machines were made of wrought iron for strength and lightness, as they had to be carried to the mines in the mountains in the interior of Mexico.

During this year Mr. R. M. Hoe filed a caveat for three plans for flying sheets cut from a continuously moving web of paper. The first method was to direct each four successive sheets, either by switches or an air blast, into four separate channels or paths, and, with a sheet-flier at the issue of each path, fly each sheet separately. The second method, as an outcome of the first, was to make the four channels or paths of such relative lengths to each other that the four successive sheets would all arrive at a given junction point simultaneously, and issue, one upon the other, to a single sheet-flier, and all be laid down together. This plan has been called 'long and short paths.' The third method was to receive on a cylinder, say, four successive sheets, one upon the other, and then

[43] Robert G. Hatfield's *The American House Carpenter* appeared in seven editions during Hatfield's life.

direct them off in a body, by switches or an air blast, to a sheet-flier to be flown together. This plan is known as the 'collecting cylinder.' This caveat was kept alive for a number of years, and the methods were eventually patented. This caveat has been of great benefit to the firm in some of the suits for infringement of its patents.

The constantly increasing business of the firm and the necessary addition of more and larger tools in every department had now resulted in a serious deficiency of motive power, and accordingly in 1854 a larger engine was put in. This was a condensing engine of 100 horsepower of the overhead beam type, from the Novelty Iron Works of this city, and a duplicate of the one then driving those works. It was placed between the boilers and the blacksmith shop in the space then occupied by the saw hardening furnace. This was a very convenient location because it allowed the engine to be geared directly to the main shaft in the saw grinding room where so much power was consumed. The boilers were lengthened ten feet to increase their steaming capacity, and a well about ten feet in diameter was sunk for obtaining condensing water. This water supply was sufficient for some time, but in after years when more power was gradually required, a series of pipe wells were driven which furnished an unlimited supply of water, and the large well was filled up. As the new engine had a surplus of power the engine and boiler were taken out of the carpenter shop and the machinery was driven by a line of shafting running through the foundry. A two story building was erected on the stable lot on the opposite side of Broome Street, in which the saw hardening furnace of a larger size was then located.

Early in 1855 the firm made for Mr. R. Raphael, Mexican Consul, 25 small steel breech loading rifled cannon of Gilbert Smith's pattern, $1\frac{1}{8}''$ bore and mounted on a regular carriage. These guns were really for the Mexican Government and intended to be used by the Dictator Santa Anna in his efforts to subdue the revolutionists in the mountains of Mexico.

The firm also built two envelope gumming and folding machines for Mr. J. D. Doubleday from his design. They operated automatically, picking up the envelopes from a pile by means of their adhesion to the gum box, thus gumming them, then folding the flaps and delivering them on to a traveling apron for drying.

Electrotype plates were now coming into use in place of stereotype plates for the better class of printing. The coating of the face of the wax molds or matrices with powdered blacklead was a very disagreeable process and had hitherto been done by a hand brush, but Mr. Joseph A. Adams, an expert wood engraver and a noted pioneer in electrotyping, patented in 1855 a machine for this purpose to be turned by hand.[44] The firm built a few machines from Mr. Adams' design, but the mechanism proved somewhat slow and noisy, nevertheless it was a great improvement on the old hand process. The firm afterwards bought this patent.

The introduction of electrotyping led to the bringing out of many other implements and machines to facilitate its various processes, such as the wax molding press, the electrotype battery, melting furnace, backing pans, shaving machines, saw tables, routing machines and a host of other articles, the whole forming a substantial addition to the firm's business.

The growth of business and the consequent demand for castings compelled the firm to increase the facilities in the foundry. A larger cupola and blower of the McKenzie pattern were put in, by which the product of the foundry was nearly doubled. The blower was of the positive pressure type, and gave such an increase of blast with such a less consumption of power compared with the former blower, that the firm built quite a number of them for sale. But they were somewhat complicated, and expensive to repair, and were gradually superseded by the Root, Sturtevant and others of improved design.

[44] U.S. Patent No. 13,516, September 4, 1855. Joseph Alexander Adams (1803-1880) 'is said to have been the first electrotyper in America.' (*DAB*, I, 93.)

In 1856 Mr. R. M. Hoe obtained an order from Mr. Edward Lloyd, of London, proprietor of *Lloyd's Weekly Newspaper*, for a Six Cylinder Type-Revolving Press.[45] Remembering the difficulty experienced in Paris in 1849 in getting the feeders in *La Patrie* office to feed the type-revolving press at 2,000 sheets per hour, it was decided to send a set of feeders to London with this press.[46] The machine was erected by Mr. William Conquest and Mr. James Blair, two of the firm's leading men, and when started on the edition at a speed of 12,000 sheets per hour it ran so successfully that Mr. Lloyd said this one trial was sufficient, and giving the feeders a handsome present, said they could return to New York.[47] Mr. Lloyd at once gave an order for a second press, and this, together with the successful running of the machine so established its reputation, and also that of the firm, that orders were quickly received from the London *Telegraph*, *Illustrated London News*, *Manchester Guardian*, Edinburgh *Scotsman*, *Glasgow Herald* and others. In view of these numerous orders from Great Britain it was decided to have Mr. Conquest remain in England to erect the machines and keep them in order.

A patent was granted to Mr. R. M. Hoe, August 5th, 1856 for an improved type bed for type-revolving presses.[48] This was a matter of great importance to the firm, for the holding of the type in the bed greatly depends in the manner in which the column rules are attached to the bed. Heretofore the ends of the feet of the rules had run in rabbeted grooves in the bed,

[45] Lloyd had seen the type-revolving press at work in the office of *La Patrie*. (Hoe, *A Short History*, p. 37.)

[46] 'One of Hoe's celebrated six-cylinder printing presses—with experienced workmen to superintend it—was sent from this city by the *Ericsson*, on the 10th inst. It is to be used for printing *Lloyd's Weekly Newspaper*, in London. This is a large first class weekly journal, having a circulation of 140,000 copies. The time was when we used to import our printing presses from London, but the tables have turned in our favor, and we are paying back our debt with compound interest.' (*Scientific American*, XI (1855-56), 289.)

[47] William Conquest, 'for 30 years London Manager to R. Hoe and Co., New York and London,' died, aged 66, in London in 1887. (*The Times*, March 8, 1887, p. 1.) His daughter became the second wife of Stephen D. Tucker in 1862. (*DAB*, XIX, 41.)

[48] U.S. Patent No. 15,501, reissued March 22, 1870, No. 3,893.

but this plan proved unreliable and even dangerous. In the new method, brass slides ran in the rabbeted grooves and overlapped the sides of the feet of the rules, and this arrangement remedied all defects and is in use in all type beds made to this day. Patented in Great Britain May 27th, 1856, No. 1,267.[49]

During this year a screw press was built for Mr. Anthony Zeraga, for pressing out the various forms of vermicelli. The bottom of the cylinder that held the dough was fitted with removable plates pierced with holes of the desired shapes, through which the screw and piston forced the dough in long strings of vermicelli. When desired, revolving knives cut the vermicelli into short pieces as it issued, forming letters of the alphabet, and other objects so well known.

During 1856 the firm received an order for a complete outfit for a Government printing office at Madras, India. Besides the many other articles ordered, there were a steam engine, boiler, shafting, three High Stop Cylinder Presses, two hand presses, etc. This order was a source of much gratification, for it was given only after a thorough examination and comparison of the merits of English and American machinery. Other machinery was sent in after years.

Rolled iron beams of various forms, for use in the construction of fire-proof buildings and other purposes were now coming into use. Messrs. Cooper & Hewitt ordered from the firm a hydraulic testing press for ascertaining the strength of various materials, but more particularly for determining the deflection of iron beams under varying pressures. The ram was ten inches in diameter and at a pressure of 10,000 lbs. per square inch gave a total force, with safety, of 350 tons. The pressure was indicated through a small piston and graduated levers.

This press was re-built two years later and made horizontal, that position being more convenient for handling the iron beams. Directly in front of the ram and at a little distance from

[49] Issued to William Edward Newton (a communication).

it, a sliding plunger is placed, the outer end of which abuts against, and gives motion to, a system of compound levers. Two iron beams with distance blocks between them at the desired distance from each other, are laid between the ram and the plunger and the pressure applied. The deflection of the beams is measured by the distance between them at the point of pressure, and the pressure applied is indicated at the same time by a sliding weight on the graduated scale beam of the levers.

In 1857 the firm bought Mr. Charles Foster's patent, dated Oct. 5th, 1852, for an improvement in hand printing machines.[50] The platen and top of the press frame were made in one piece, and the power was applied beneath the ribs and thus lifted the ribs and bed up against the platen. The Washington Press works were used and the bar handle was put in the same position, so that the pressure applied was the same as in that press, and it was named the Improved Washington Press (Plate XII). The arrangement made a very low and attractive looking press with the form well exposed to the light. A few of them were made, but from prejudice or some other cause it never became popular and after a few years its manufacture was abandoned.

An order was received from the Directors of the New York Central Railroad for a ticket printing machine from our own designs. The machine as built was a true web press. The forms were engraved or cut on a cylinder with the names of the stations in movable type, and printed on a roll or ribbon of paper. The tickets were numbered consecutively in a different colored ink from the body of the ticket, cut off from the roll and deposited in numerical order in a receptacle at a speed of 10,000 per hour (Plate XIII).[51] Similar machines were built for the N. Y. & Erie and other roads.

[50]U.S. Patent No. 9,295, issued to Charles Foster, Cincinnati, Ohio. An illustrated article about Foster's press, then manufactured in Philadelphia, is in *Scientific American*, IX (1853-54), 121.

[51]U.S. Patent No. 23,172, March 8, 1859, issued to Richard M. Hoe.

There was made during the year for Captain Burrows, the British Consul at New Orleans, a small steel breech loading rifled cannon, 1 ¼ inch bore.[52] It was mounted on wheels in the usual style, but was intended probably more as an experimental piece than for actual use.

A patent was granted to Mr. R. M. Hoe, November 10th, 1857, for a method of feeding sheets of paper to an impression cylinder by means of a feeding cylinder, a drop roller and conveying tapes, and on November 17th, 1857, he obtained a patent for a method of operating sheet-fliers of a printing machine.[53] Both of these patents were for improvements more particularly applicable to Type-revolving presses, and necessitated by the increased number of impression cylinders with which these machines were then being built. Patented in Great Britain, June 10th, 1857, No. 1,635.[54]

In 1857 the firm made for Mr. William Moultrie a Rotary printing and gilding press for printing hat linings and similar work, which, it was said, had heretofore been done on a hand gilding press. This was a somewhat expensive machine, the rollers carrying the dies being heated by steam. Mr. Moultrie had great expectations from it, but I never heard from it after we put it up in his office.

During the past years the making of saws, both long and circular, saw mandrels, veneer saw mills and other appliances for sawing, had become an important branch of the firm's business. In 1857 a large and powerful hydraulic press was built for flattening saws, which were put into the press hot, as they came out of the tempering furnace, and received a great pressure. This seemed to flatten the saws somewhat but for some reason was not satisfactory and it was gradually abandoned.

During this year Mr. Robert Hoe, who was then abroad,

[52] According to the city directory, William Mure was British Consul at New Orleans. (*Mygatt & Co.'s Directory*, comp. W. H. Rainey, New Orleans, 1857, App. p. 61.) Captain Burrows may have been on special assignment.

[53] U.S. Patents No. 18,589 and No. 18,640.

[54] Issued to William Edward Newton (a communication).

obtained an order from the London *Times* for two Ten Cylinder Type-Revolving Presses, on condition however that they should be built in Great Britain, the proprietors of the *Times* probably feeling that their interests would in some way be compromised if it were known that they were using presses imported from the United States. Mr. Hoe therefore contracted with Messrs. Whitworth & Co., of Manchester, to build the machines from our drawings, and they were erected in the *Times* office in the following year where they did good duty until superseded by the Walter web press some eight or ten years later.[55]

Early in 1858 Mr. A. B. Taylor offered me a partnership in his business of making printing and kindred machinery. When I mentioned the matter to Messrs. R. Hoe & Co., Col. Hoe said that the firm had already decided to admit me as a partner in the near future, but that under the circumstances I would be admitted at once, and a proper agreement would be signed on the return of Mr. Robert Hoe, who was then in Europe. This arrangement was duly carried out and the agreement signed May 28th, 1860.

In 1858 Mr. R. M. Hoe filed a caveat for a Web printing machine to print four webs from two type cylinders carrying wedge shaped type. Each column of type is put in a galley, one side of which is formed into a column rule, and these galleys are secured around a cylinder and run parallel with its axis. Four impression cylinders are placed around this type cylinder with an inking apparatus between each, and each is supplied with a web of paper from a roll. A second type cylinder with its four

[55] 'The people at Printing House Square had been slightly shocked in 1856 when Lloyd, the Sunday newspaper proprietor, ordered one of Hoe's flat-bed [sic] six-cylinder machines from its inventor. The shock lay in the novelty, the cost and the efficiency of the machine. When this was known John Walter made a thorough investigation of his machine room, and visited Philadelphia to examine the machine room of the *Public Ledger*. He decided that the Americans were ahead of Printing House Square and all London, and ordered two ten-cylinder Hoes, which cost him the then enormous sum of £6,000 each, the price being cut by MacDonald to £10,000 for the two.' (*Printing The Times Since 1785*, London, 1953, p. 44.)

impression cylinders, is placed a little distance from, but parallel with, and connected to, the first one, and the four webs after being printed on their first side are guided to the second set of cylinders in such a manner that their unprinted sides are presented to the type cylinder and printed. Each web then passes between a pair of cutting cylinders furnished with a serrated knife, but having here and there a tooth removed so that the sheets are still slightly joined together. The sheets may be flown by a rotary sheet-flier which is composed of four fliers on a horizontal shaft, each flier being made up of two pivoted sections. As these revolve each flier strikes a partially cut sheet as it descends, tears it loose from the web, carries it around and deposits it on a narrow fly-table, the two sections then turning edgeways and passing one on either side of the table. The sheets also may be flown by an oscillating sheet-flier, which, as it oscillates strikes the descending sheets, tears them from the web and deposits them to the right and left alternately on inclined fly-tables. Or the sheets may be flown by two horizontal inverted sheet-fliers placed one above the other. The partially cut sheets are torn from the web by faster speed rollers and tapes, which conduct them to the two sheet-fliers to which they are directed alternately. The sheet-fliers are slightly inclined upwards and have tapes running just beneath them and the sheets are kept against the under side of the tapes by an air blast until they arrive at their proper position when the flier descends and deposits them on the fly-table. Another method of flying the sheets is by a revolving cylinder divided into, say, four compartments, the circumference of which is pierced with air holes, and in each compartment there is a bellows connected with these holes. As the cylinder revolves and each compartment meets a sheet which has been detached from the web, its bellows expands and sucks the sheet to the surface of the cylinder which carries it around over a fly-table, when the bellows is compressed and the blast deposits the sheet on the table. Or the web may be folded uncut in a zig-zag pile by

passing through an oscillating pendulous frame which deposits it on a concave table just below it, a clamp being placed at each corner of the table to hold the paper in position as its direction is reversed. The frame makes a stroke for each sheet printed and the paper is so timed that the margin between two sheets is laid in the center of the table, and when the web is run off the pile of paper is cut through the margin on a cutting machine, thus giving the sheets in a once folded condition. None of the above devices, however, have been patented in the United States.

About this time Mr. William L. Colby devised a plan for driving the type bed of cylinder presses through a universal joint. The driving or outer portion of the joint shaft is made large and hollow, and the joint is put inside of it at its extreme outer end. This arrangement makes the driven portion of the shaft that carries the double rack pinion, very long, and consequently its angle is very slight, and this so reduces the irregular motion of the joint shaft that it is no longer perceptible in the movement of the type bed. This device was adopted for the Double Cylinder, Single Small Cylinder and Two-Revolution Presses as it is now used, and the Double Cylinder Presses previously built with the bevel wheel driving arrangement heretofore described, were gradually altered to this plan. This device for some reason was never patented.

About 1858 the firm introduced a simple, light running, Drum Cylinder Hand Printing Machine, called the Country Press, intended more particularly for country offices without motive power (Plate XIV). This is a good, serviceable machine for country newspaper and job work, and is well appreciated, for it is still being made, although naturally somewhat modified and improved.

There was also brought out a Book rolling or pressing machine, but few of these were ever built, bookbinders seeming to prefer the large embossing press for that purpose.

The firm made for Messrs. Mora & Nephew, two sugar packing machines. The machine was composed of two vertical

stamps worked by cranks overhead. Below was a platform which rose and fell and on it was placed the packing box. As this box was gradually filled and packed the platform receded.

During 1858 we built in our experiment room a full size web cutting and folding machine for sheets the size of an eight page *New York Herald*, with cutting cylinders which cut the sheets from a web or roll of paper. As the sheets descended from the cutting cylinders the first folding blade, which vibrated horizontally, struck the sheets centrally and carried them to the right and left alternately, and the subsequent manipulations were the same for either sheet. Suppose a sheet be struck to the right, the folding blade carried it, double edge first, in between a pair of horizontal plates, where it was retained, thus folding it to two page size. As the blade withdrew from the sheet a second folding blade descended vertically through a slit in the plates, struck the once folded sheet centrally at right angles to the first fold, and carried it through the slit and in between a pair of vertical plates, thus folding it to page size. As the second blade withdrew from the sheet a third blade struck it horizontally through a central slit in the plates and carried it through and into the bite of a pair of nipping rollers, thus folding it to half page size. The nipping rollers delivered the sheet onto a double set of arms, which, when say twenty-five sheets were accumulated suddenly swung down to the right and left and let the pile drop squarely onto a slowly traveling apron, and quickly returned in time for the next sheet. This machine would fold 8,000 to 10,000 per hour. But the problem of successfully covering a small cylinder with a printing surface suitable for newspaper work was not yet solved. Besides, it was discovered that a patent for folding between plates had been granted to Mr. George K. Snow, in 1850, so nothing further was done in the matter.[56] Our peculiar

[56] U.S. Patent No. 7,722, October 15, 1850, issued to George K. Snow, Boston, Mass. A biographical sketch of George K. Snow (1826-1885), inventor and manufacturer, is in *Annals of the Massachusetts Charitable Mechanic Association, 1795-1892* (Boston, 1892), pp. 432-433.

form of cutting knife used in this machine was patented several years afterwards by Mr. William Bullock.[57]

The firm built this year a hydraulic press for making lead pipe. The ram of the press was 8 inches in diameter, and a continuation of it extended upwards into the lower end of a cylinder which held the lead in a partly molten state. The upper end of this cylinder, which was formed in the head of the press, was fitted with a removable die-plate with a hole through it the size of the outside of the pipe to be made, and inside of the cylinder a steel core was secured which extended up centrally through the hole in the die-plate. As the ram of the press was pumped up, the partly melted metal in the cylinder being sufficiently hard to retain shape, was forced through the hole in the die-plate in the form of a seamless pipe, which was wound on a reel as it issued.

There was also made just at this time a candle press for Mr. M. H. Eagle. It operated in much the same manner as the lead pipe press, except that the plunger entered the cylinder from the top. The die-plate was in the side of the cylinder near the bottom, and a pointed tube passed in through the side of the cylinder directly opposite, with the point entering centrally the hole in the die-plate a short distance. The wick for the candle entered through this tube, and as the wax or stearine in the cylinder was forced down by the plunger and issued through the hole in the die-plate, it carried the wick out centrally with it.

There were also some machines made for Mr. Leroy M. Fairchild, likewise for Alexander Morton, for making gold pens, machines for cutting out the blanks, curving them into shape, etc.

The New York Central Railroad were seemingly so well pleased with the Web ticket printing machine we built for them that they ordered a Web coupon ticket machine made on the same principle. This machine printed a ticket with ten

[57] U.S. Patent No. 38,200, April 14, 1863, issued to William Bullock, Pittsburg, Pa., assignor to Himself, Calvin Adams, and Geo. S. Selden, of the same place.

coupons, or less, numbered them consecutively in a different color from the body of the ticket, printed a line of perforations between the tickets and also between the individual coupons, so that all could be easily detached when used, and folded the tickets still attached, in zig-zag form in a pile. Now it was desired to preserve these numerous coupon forms for future use, and as stereotyping from a flexible papier-mâché matrix had not yet come into use, the only way was to electrotype them. But it was found next to impossible to bend the copper electro shells to the small curve of the printing cylinder and preserve a good printing surface, and I was told that after much experimenting the use of the machine was abandoned.

In 1859 the firm made for Messrs. Salters [Saltus?] & Co. two cast steel howitzers, one 2½ inches calibre and rifled, and the other three inches calibre smooth bore, and mounted on a carriage. I understood that these were intended to show the superiority of steel for such guns.

A portable saw mill was built this year for Mr. Pearson Crosby. It was driven by a portable engine and was intended to be set up anywhere in the forests and moved from place to place as required, the trees to be cut down and sawed into lumber on the spot. Mr. Crosby said there would be money in this, for it would save the expense of hauling the logs to a saw mill and carting the lumber back to where needed.

There was also made for the New York Belting and Packing Co. a small rotary press for printing their trade mark, or label, on webs or rolls of corrugated rubber cloth. Quite a number of these were made for different parties.

During this year the firm brought out a Single Small Cylinder Press arranged to print two or more colors at one operation. A form for each color was put on the type bed and each form had its inking apparatus, and as the bed traveled the impression cylinder, with a sheet, made a revolution over each form and discharged the sheet. This would give perfect register if the forms were properly adjusted, but the printers objected

that it was very difficult to make the several forms so perfect that the impression from one form would exactly meet and not overlap that of another, and that if it overlapped the freshly printed inks would intermingle and destroy the color. That this objection was not a valid one is evident from the fact that machines are now successfully printing two or more colors at one operation. We made but three of these machines and they soon disappeared. There was nothing particularly new in the arrangement. It was a French invention and was there applied to a stop cylinder press and patented several years previous. It was simply brought out before its time, as was the case with the Two Cylinder Perfecting Presses the firm built in 1844 and which are now so extensively used.

During 1858 a copperplate printing machine was built for Mr. D. Steffens, from the designs and directions of Mr. Robert Neale.[58] This was a large and expensive machine. The printing plate bed was attached to a pair of endless chains which carried it along horizontally with the printing plate face upwards under the impression cylinder and an inking apparatus, and returned it underneath with the printing plate face downwards, where the wiping and polishing operations were performed. The machine was tried and altered many times in the factory and printed ordinary work fairly well, but it never cleaned and polished the plate sufficiently well for first-class work.

Mr. Isaac Adams, of Boston, had previously proposed to Messrs. R. Hoe & Co. to sell them his entire interest in the manufacture of printing and kindred machinery and retire from that business. Terms were finally arranged in March, 1859, by which the firm bought all Mr. Adams' patent rights, tools, stock and patterns for printing and embossing machines, stand-

[58] British Patent No. 128, January 18, 1853, issued to Robert Neale, Pentonville, Middlesex. On June 20, 1854, 'Robert Neale, of Clermont county, in the State of Ohio and United States of America, a citizen of the United States, but now temporarily residing in London' applied for the American patent which was granted as U.S. Patent No. 12,213, January 9, 1855.

ing presses, paper cutting machines, etc. (Plate XV). The firm also leased the factory in South Boston and continued there. Mr. A. S. Bowen was made Superintendent of the works and held the position until he retired in 1863, when Mr. T. H. Mead took charge.

A patent was granted to Mr. R. M. Hoe, July 26th, 1859, for a method adapted to a Type-revolving press for printing both sides of a sheet by the same impression cylinder, but from different forms on the type cylinder.[59] The sheets may be either fed by hand or cut from a roll. This invention is already described on page 389.

A patent was granted to Mr. R. M. Hoe, August 23rd, 1859, for a device for cutting sheets of various lengths from a roll of paper and feeding them to a perfecting press.[60] The paper is drawn from the roll continuously by a pair of drawing rollers whose speed can be varied by means of change wheels to make a sheet of greater or less length. This is cut from the roll, except that it is left joined by a few filaments, and enters into a series of loosely running tapes which conduct it to the impression cylinder, the fingers of which seize it, tear it from the roll and carry it around to be printed.

For some years past there had been published a popular paper called the *Brother Jonathan*, owned or edited by Mr. George Roberts. Messrs. R. Hoe & Co. had built a large double cylinder press for this paper a short time previous, which was of course duly announced to the public in its columns. On the 4th of July, 1859, the paper issued a holiday edition called *The Constellation* which was a great curiosity, as well as a great wonder, to the general public.[61] This sheet

[59] U.S. Patent No. 24,875.

[60] U.S. Patent No. 25,199, reissued June 30, 1874, No. 5,947.

[61] According to the city directory, *Brother Jonathan*, 48 Beekman Street, was owned by B. H. Day and the *Constellation*, 12 Spruce Street, was owned by George Roberts. (*The New York City Register*, comp. H. Wilson, New York, 1859, p. 34.) Roberts had previously published a 'mammoth' periodical, the *Notion*, in Boston. (Frank L. Mott, *A History of American Magazines 1741-1850*, Cambridge, Mass., 1966, p. 361.) It is probable that Roberts had the *Constellation* printed on the *Brother Jonathan* press.

measured 6 ft. by 8 ft. 4 inches, each of its eight pages being 36 x 50 inches, and much speculation and discussion were indulged in about their new monster press that could print such a sheet.[62] As a matter of fact, it was folded to page size and printed on their ordinary press by refolding and running it through eight times.

A patent was granted to me September 6th, 1859, for a method of operating the fingers of a printing machine.[63] One end of the finger rod carries a disk which has a groove cut across its face. Two studs are fixed to the press frame, one just outside and the other just inside the circular path of the finger rod. As the impression cylinder revolves the outer stud enters the outer end of the groove in the disk and turns the finger rod sufficiently to make the fingers on it grasp a sheet, and as the cylinder continues its revolution the inner stud enters the inner end of the groove and returns the fingers to their first position, thus releasing the sheet. A spring catch holds the finger rod in its two positions. This finger motion was at once adopted, and with a modification, is still applied to our Two-revolution and some other styles of presses.

The first Type-revolving press for Australia was sent out during 1859. It was a six cylinder press ordered by the *Sydney Morning Herald* and was erected by one of our workmen sent out for the purpose. The machine worked so successfully that the *Herald* ordered a second one a few months later. This was the beginning of an important business in printing machinery with the Australian Colonies, which has constantly increased to the present time.

The method of stereotyping with a flexible papier-mâché matrix appears to have been a French invention. It had been practiced somewhat in France and England for several years, and was being gradually improved and coming into use. Mr.

[62] George Roberts, 'Editor and Publisher,' printed 28,000 copies. (*Constellation*, July 4, 1859, p. 8.) No other issues have been located in *American Newspapers 1821-1936*, ed. Winifred Gregory (New York, 1937), p. 463.

[63] U.S. Patent 25,356, assigned to R. M. Hoe, R. Hoe, and P. S. Hoe.

Chas. Craske, a stereotyper, introduced it into his office in New York about 1854, and in 1857-8 he tried to induce the proprietors of several of the newspapers in this city to stereotype their forms by this process but without result.[64] In 1859 Mr. Robert Hoe, who was then in Europe, sent to the firm here a curved stereotype page of the London *Times*, which had been worked on their press, and stated that this process of stereotyping was in successful use in that office. Finally, in 1860 Mr. Craske made a contract with the proprietors of the *New-York Daily Tribune* to stereotype the forms of that paper. We made the stereotype mold, shaving machine, beds, etc., for this purpose, and after some little experimenting the result was so favorable that stereotyping was soon adopted by the *New York Herald*, *Sun*, *New-York Times*, and other papers. The success of this quick process of stereotyping was of immense benefit to newspapers of large circulation, for it enabled them to duplicate their forms and use additional presses, and it was also of much importance to Messrs. R. Hoe & Co., for they were called on to supply the additional presses required.

In 1860 the firm bought Mr. Andrew Overend's patent for a machine for wetting sheet paper in quires.[65] A few of these machines were built and they performed well, but occupied considerable space and required adjusting for the various sizes and qualities of paper. For these reasons probably they never came into general use.

A machine was made for cutting the thread on wood screws for Mr. C. W. Smith from his designs, and of which he had great expectations, but I never heard from it after it left the factory.

Early in 1861 two ticket dating machines were made for the

[64] Biographical information about Charles Craske (1822-1905) is in *Am. Dict. Printing and Bookmaking*, p. 124, and *Publishers' Weekly*, LXVIII (1905), 1881.

[65] Andrew Overend, Philadelphia, Pennsylvania, received two patents for machines for wetting paper: U.S. Patent No. 10,627, March 14, 1854, and U.S. Patent No. 28,895, June 26, 1860. A long article about Andrew Overend is in *Mirror of Typography*, III (1871), 17-18.

New York and New Haven Railroad Co. They were worked by the foot and the type was inked by a compo roller. Several were made for other parties, but they were all superseded by the hand stamp and ink-saturated ribbon.

The firm brought out at this time a Card press under a patent granted to Mr. Franklin L. Bailey June 23rd, 1857, and assigned to Messrs. R. Hoe & Co. (Plate XVI).[66] This press was so convenient and light running that it at once became popular and soon superseded our 'Machine Card Press' that had been in use for the previous fifteen years (Plate XVII). Patented in Great Britain May 22nd, 1861, No. 1,304.[67] This press was adapted to receive a numbering apparatus in 1865 and called a 'Numbering Card Press' (Plate XVIII). Cards, theater tickets, railroad tickets, etc., are printed and numbered consecutively at one operation and deposited in a trough in numerical order.

A small machine was made for Mr. I. S. Sammons for sawing and dressing slate into form for roofing, school slates or any other purpose.

The war of secession had now commenced and business of all kinds was completely prostrated except for war supplies and materials, and the firm took hold of anything that seemed profitable.

The New York Desiccating Co. ordered two large hydraulic presses fitted with iron boxes and plungers for pressing into the smallest space possible desiccated meat, vegetables, in fact all kinds of food, for army rations. It was said that when thus compressed the articles were but one-tenth to one-twentieth of their original bulk.

The firm received several orders from the U.S. Armory at Springfield, Mass., for a number of the machines required in the manufacture of rifles for the army. Orders were also re-

[66] On June 23, 1857, Franklin L. Bailey, Boston, Mass., was granted U.S. Patent No. 17,615 for a 'Printing-Press,' but his 'Card-Printing Press' was patented seven days earlier under U.S. Patent No. 17,549.

[67] Issued to William Edward Newton (a communication from Stephen Davis Tucker).

ceived for similar machines from Mr. James T. Ames, Messrs. Hoard & Son, Mr. William Mason, Messrs. Denslow & Chase, Messrs. Alfred Jenks & Son and others, who had taken contracts for making arms for the Government. Thus, during 1861-2 the firm built about sixty machines of various kinds, for working in both metal and wood, such as turning, boring, milling, stocking, porfiling, punching, squaring, tapping, threading, rifling and other machines, the drawings and patterns for which were furnished by the U.S. Armory.

During 1861-2 a newspaper addressing machine was built for Mr. J. Battey under his direction.[68] This was quite a large and expensive machine, intended for newspapers having a large circulation by mail. The addresses were stereotyped and attached by clasps to a light strip of wood, four in its length. A chain link was secured to each end of each strip, of a form that permitted them to be easily attached to, or detached from, others, so that an address, or a line of them could be quickly inserted or removed. A large number of these strips were joined together and wound up into a roll about 18 inches diameter, and when put into the machine, the chains ran on sprocket wheels which slowly unwound the roll of addresses, passed them under inking rollers and an impression cylinder and rewound them. The folded newspapers were put in piles four abreast, and the bottom one of each pile was automatically fed forward to each line of addresses that passed, and was printed by the impression cylinder. This machine was put in the office of the *New-York Daily Tribune* where Mr. Battey was with it for a long time, but it probably was not satisfactory, for it came back to the factory and was finally broken up.

In 1862 the firm introduced the 'Railway' newspaper press, a machine designed to do the newspaper and job work of a country office, and to run exclusively by hand (Plate XIX). It is a stop cylinder press, driven by a crank which connects with

[68] U.S. Patent No. 26,827, January 17, 1860, issued to Jesse Battey, Honeoye Falls, N.Y. Although the patent was issued to Jesse Battey, the drawing is signed Jesse Batley.

a four wheel truck that runs on a track on the bed plate. This truck carries the type bed, and has a wheel which gears into a rack on the bed plate and also into one on the underside of the type bed, thus the travel of the bed is twice that of the truck, and consequently the crank arm is short and permits the press to be built quite low. This arrangement for driving the bed was copied from a style of press made by Marinoni, of Paris.[69] The sheets are fed to the underside of the impression cylinder which shortens the travel of the bed and makes the press light running, and it still remains a useful machine of its class. Patented in Great Britain May 22nd, 1861, No. 1,304.

Early in 1862 the firm built two powder compressing machines, one for the Hazard Powder Co., and the other for the du Pont Powder Co., for pressing cannon powder into cakes to facilitate loading the guns, which at that time were all muzzle loading. The machines were built from our own designs and consisted of a strong iron frame, having a table with an intermittent rising and falling motion, a horizontal iron disk pivoted to this table having an intermittent circular motion, and these two motions operated alternately. Four brass molds of the required size were inserted in the disk, and two brass pistons were fitted in the head of the machine above the disks, at opposite points. At a stoppage of the disk in its revolution a charge of powder from a reservoir ran into a mold, at the next stoppage this powder was compressed by a piston, at the third stoppage a short wooden block was dropped into the mold onto the compressed cake and at the fourth stoppage the block and cake were, by the second piston, discharged through the bottom of the mold. Each mold in succession produced a cake. Thus, the machine would turn out from 30 to 40 cakes per minute, from 3 to 6 inches in diameter. Patented in Great Britain August 11th, 1862, No. 2,239.[70]

[69] Hippolyte Marinoni (1823-1904), inventor and publisher. (*La Grande Encyclopédie*, Paris, 1886-1902, XXIII, 191; *Grand Larousse Encyclopédique*, Paris, 1963, VII, 97-98.)

[70] Issued to William Edward Newton (a communication from Stephen Davis Tucker).

A small cartridge machine was built for the du Pont Powder Co., for compressing a charge of powder onto the base of a conical rifle bullet. In design this machine was much like the larger one. The base of the bullets was coated with a glutinous substance, and as the disk of the machine revolved they were dropped, point foremost, into conical holes in it. They then passed under a reservoir and received a charge of powder, next under a piston, which pressed the powder hard onto the base of the bullet and then over another piston which forced the cartridge up out of the hole. The fatal defect of this style of cartridge was that the powder could not be made to adhere sufficiently firm to the base of the bullet, and they never came into use.

The Government had now commenced to issue paper money of various kinds to meet the expenses of the war, and contracts were made with several Bank Note Companies to print this money. The American Bank Note Co., the National Bank Note Co. and the Continental Bank Note Co., all of this city, received contracts, and were obliged to greatly increase their printing facilities. Each company gave the firm an order for fifty copperplate presses with which to begin operations, and these were supplemented from time to time by lots of twenties and tens, as necessity required. A number of hydraulic presses were also made for each company to press the printed sheets.

A new bed and platen job press was built at this time and called the 'Caxton Press.' It was made under a patent issued to Mr. Franklin L. Bailey, February 21st, 1860, and assigned to Messrs. R. Hoe & Co.[71] It was driven by a treadle and would print a sheet 9 x 12 inches. The form was vertical and the platen, which was pivoted to the frame, fell back to a state of rest at such an angle as to be very convenient to lay a sheet on. The impression was given through a crank and connecting rod, the platen was arranged to stop and start without jar and the impression could be thrown off as well. But the press

[71] U.S. Patent No. 27,197, issued to Franklin L. Bailey, Boston, Mass.

never was a favorite. Printers objected to the pivoted platen of the press meeting the form at an angle. The Gordon Press was already in the field and liked, and its platen approached the form squarely. Probably for these and other reasons they were not in demand, and their manufacture was finally given up. Patented in Great Britain, May 22nd, 1861, No. 1,304.

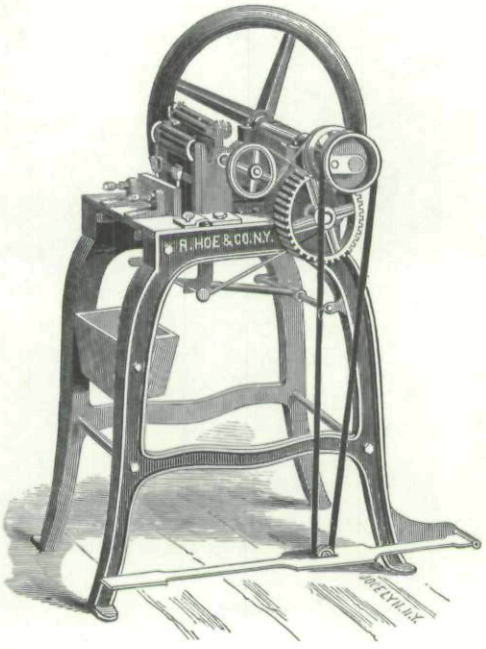
During this year the Superintendent of Public Printing ordered a Four Cylinder Type-Revolving Press and the necessary outfit for making curved stereotype plates, and these were erected in the Government Printing Office, in Washington, early in 1863.[72] The machine was built specially for the work it was intended to do, but when it was put to work it met with the most determined opposition from the printers in the office. The blankets and compo rollers were found cut and accidents happened to the machine continually and no one seemed able or willing to master it. The obstacles and delays became so serious that the use of the machine was finally abandoned.

The method of making the curved stereotype plates for this machine was entirely new. A thin sheet of tempered steel, whose normal form was the required curve of the stereotype plates, was drawn down flat on an iron plate, and in that position was coated with clay into which the form of type was impressed. The steel plate was then released and resumed its natural curve, the clay was dried and put in a curved mold and the stereotype plate cast in the ordinary manner. This method produced excellent plates, and it is now being used with wax instead of clay for making curved electrotype plates for the Rotary presses now in use for the finer class of printing. Patented in Great Britain, February 25th, 1863, No. 529.[73]

In 1863 a number of paper working machines were made for Mr. T. G. Bergen, consisting of two sets of rotary cardboard cutters, two presses for cutting out and embossing cardboard

[72] The cost of '1 large Hoe's cylinder press, engine, and fixtures' was $15,714.92. (*Annual Report of the Superintendent of Public Printing*, House Misc. Doc. 21, 38th Cong., 1st Sess., p. 13.)

[73] Issued to William Edward Newton (a communication from Richard March Hoe).



R. Hoe & Co's Patent Machine Card Press.

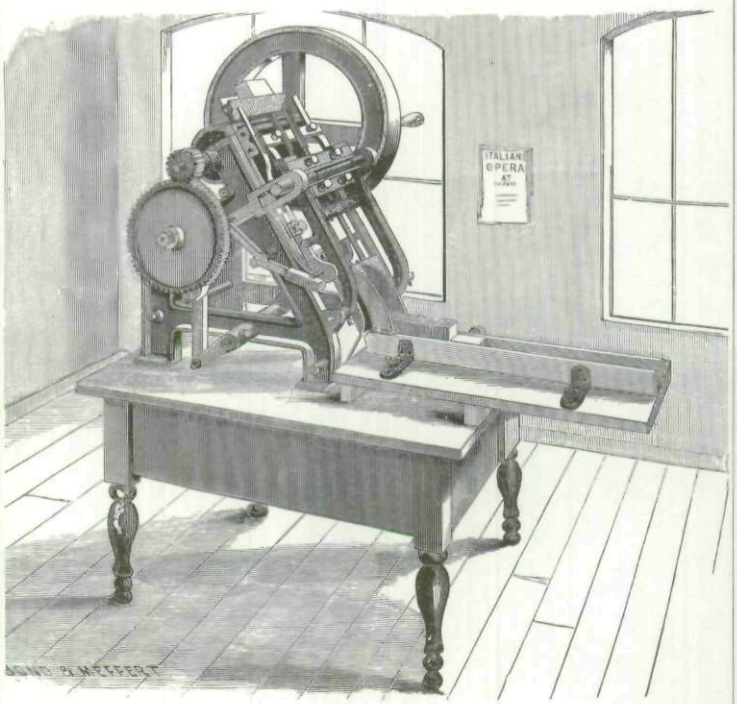
For printing Cards and small Circulars this machine is not surpassed. It is worked by either a crank or treadle, and will print from 1,000 to 1,500 cards per hour in the best manner.

Price, $150.

Size of chase inside, 5 × 6¼ inches.

Boxing and Carting, $2.50.

Plate XVII.—R. Hoe & Co., *Catalogue*, 1860.



Patent Numbering Card Press.

This Press is designed for printing and numbering, at one operation, railway tickets, theatre tickets, checks, and all cards of a similar character. Its general arrangement is the same as the Card Press on page 56, with the additional mechanism for numbering the tickets consecutively and depositing them in a trough in numerical order. It will number up to 10,000, and the wheels can be set at 0 or at any required figures with great facility. The machine is set on a hard wood table furnished with drawers for roller stocks and other implements.

A Roller Mould, two sets of Roller Stocks and three Chases are furnished with the press. Platen, $4\frac{1}{2} \times 6$ inches.

Price, $400.

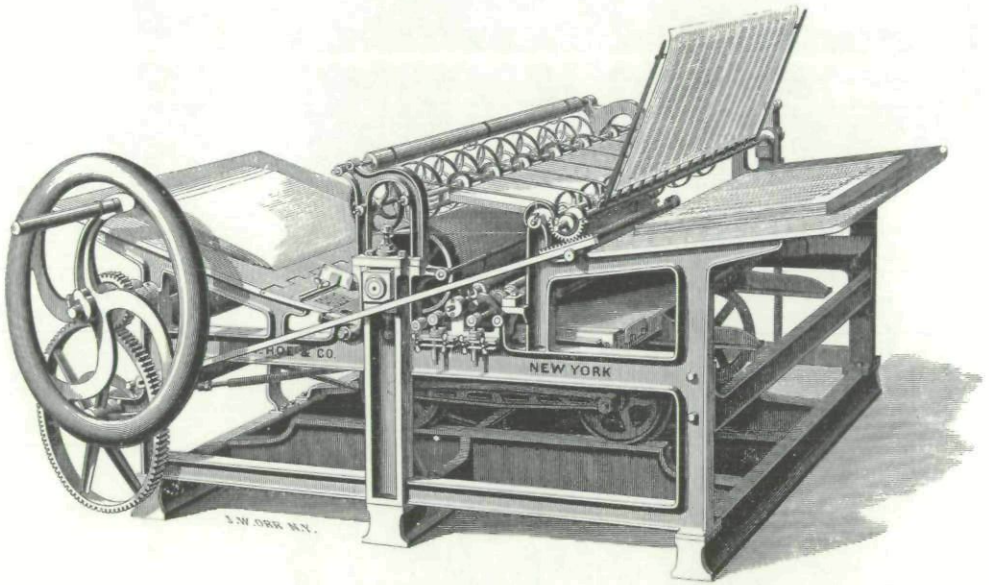
Boxing and Carting, $5.50.

For printing higher numbers, extra.

Driving Pulley, Fast and Loose Pulleys, Counter-shaft, Hangers and two Cone Pulleys, for steam power, extra, $50.

Terms of Payment—Cash at manufactories.

Plate XVIII.—R. Hoe & Co., *Catalogue*, 1867.



Railway Newspaper Printing Machine.

Plate XIX.—R. Hoe & Co., *Catalogue*, 1867.

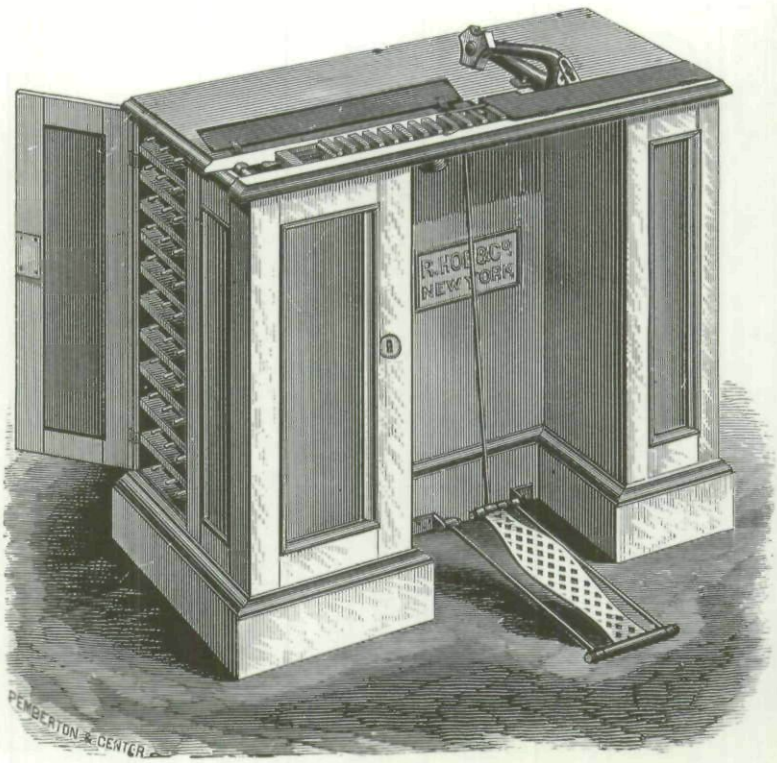
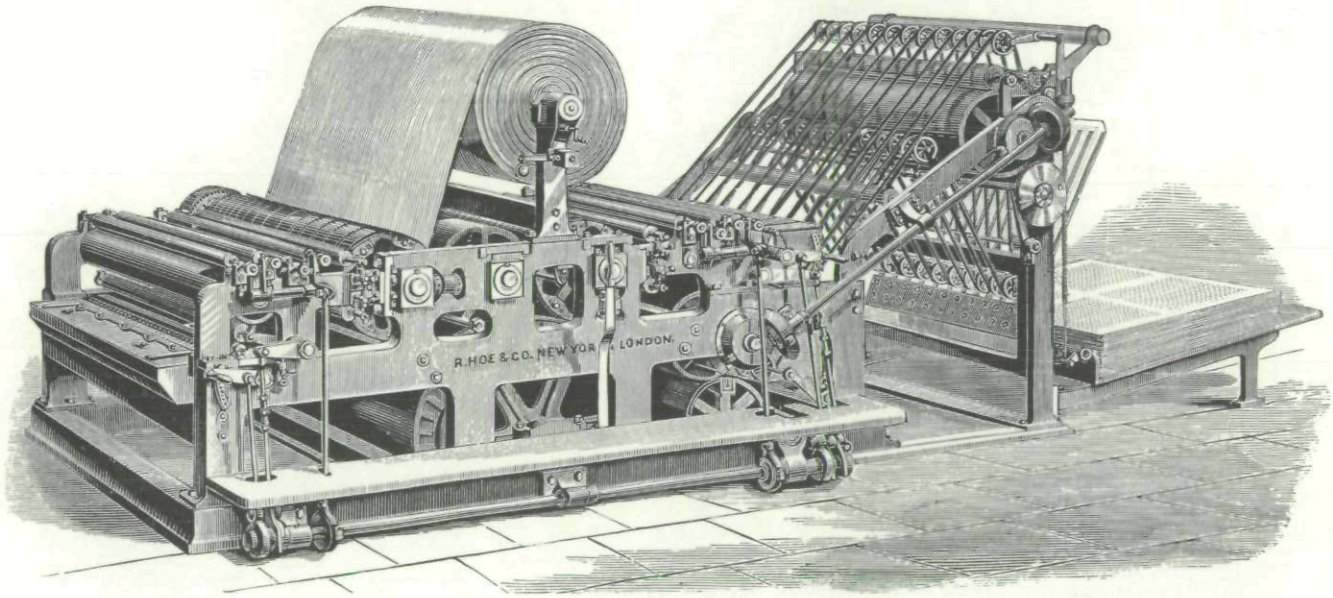
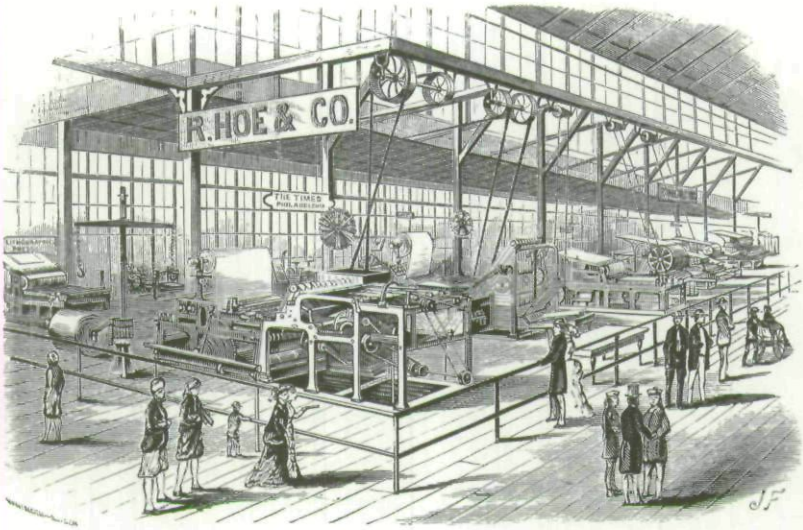


PLATE XX.—R. Hoe & Co., *Catalogue*, 1879.



FIRST HOE WEB PRESS

PLATE XXI.—From Robert Hoe, *A Short History of The Printing Press* (New York, 1902).



HOE'S PRINTING-PRESS EXHIBIT.

PLATE XXII.—From E. C. Bruce, *The Century: Its Fruits and Its Festival* (Philadelphia, 1877).

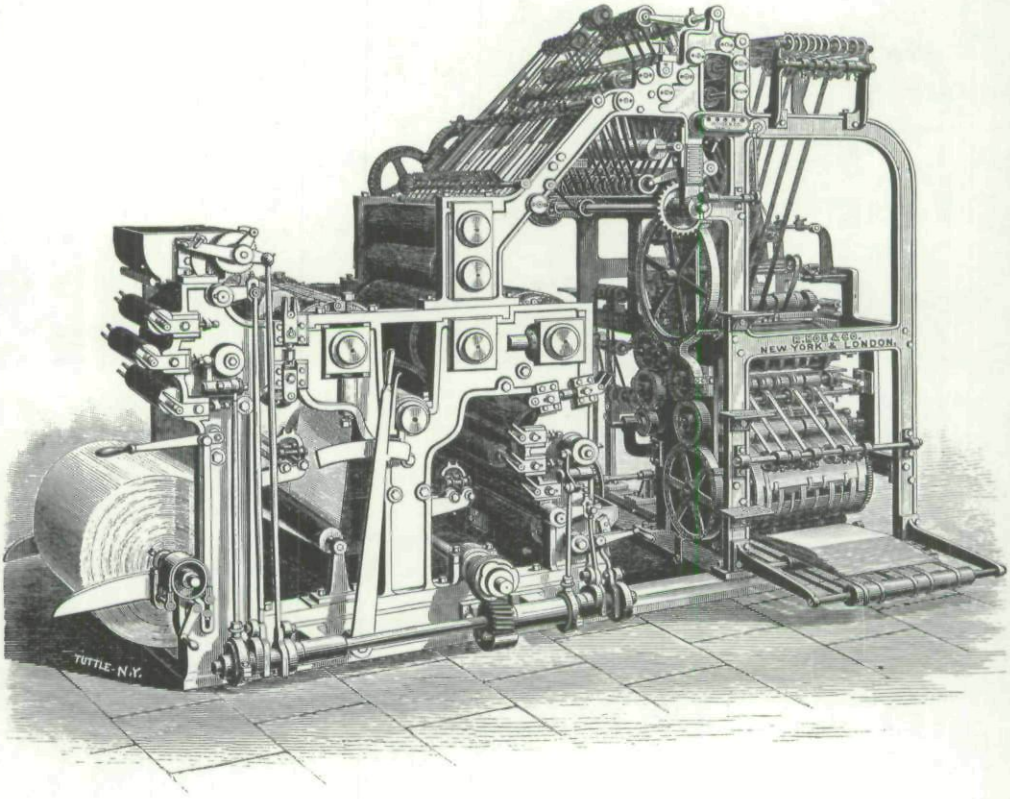
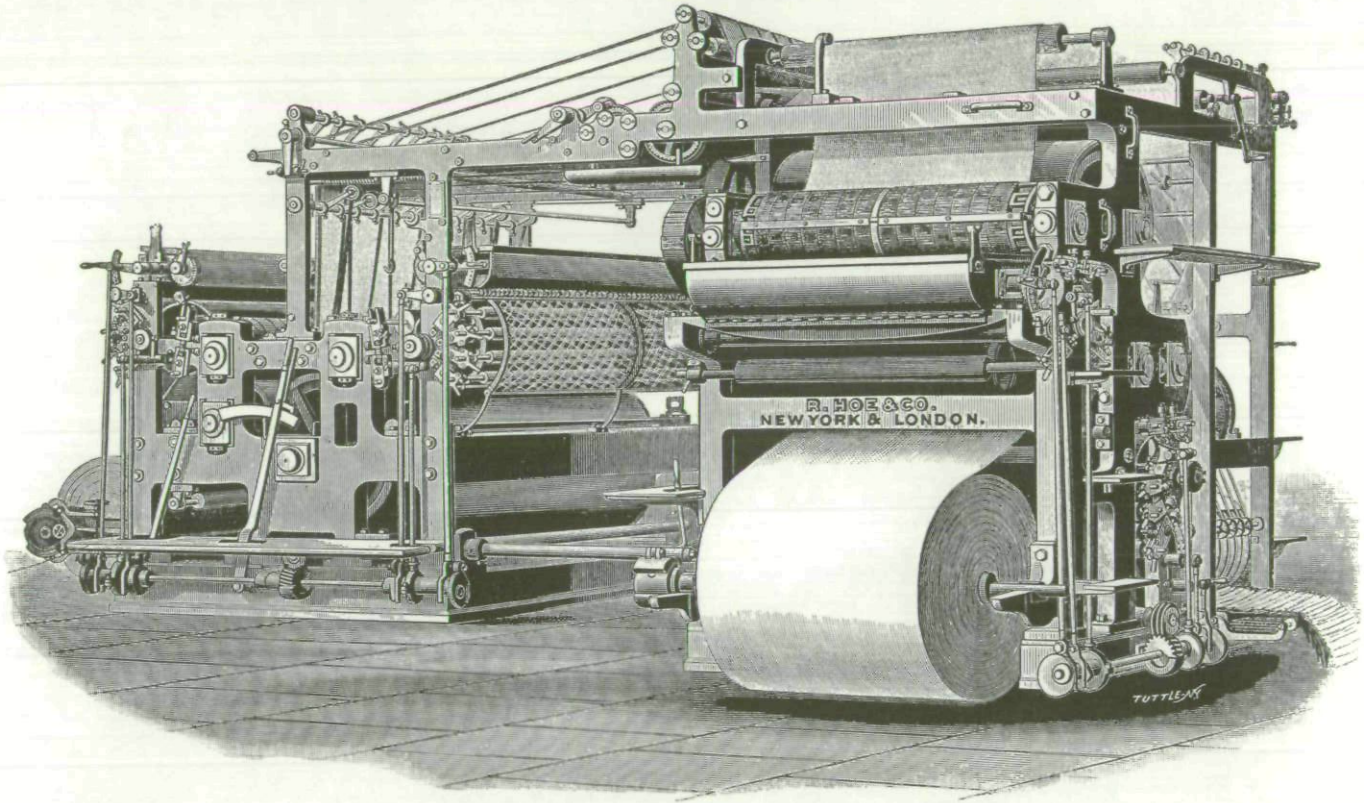


PLATE XXIII.—The 'Presto' Patented Stereotype Perfecting Printing Machine (*Inland Printer*, February, 1885).



DOUBLE SUPPLEMENT PRESS

PLATE XXIV.—From Robert Hoe, *A Short History of The Printing Press* (New York, 1902).

for framing pictures, photographs, etc., an eyelet punching and riveting press, an automatic Tag and Label cutting machine working from a ribbon of paper, and a quantity of punches, dies, etc. for these machines.

Messrs. A. W. Denmead & Son, Baltimore, ordered two 12-inch hydraulic cylinders with rams and pumps. These were to be put in a press for bending iron plates for Monitors and their turrets then being built. A pair of these cylinders were also made for Messrs. Cornell, of this city, and a pair for the Niles Works, Cincinnati.

Mr. R. P. Parrott, Cold Spring Foundry, ordered two 6-inch hydraulic presses and pumps for forcing the conical shot and shells for Parrott rifled guns through cutting or shaving dies to make them suit the bore of the guns. This was a very expeditious and successful operation, for the projections that enter the rifling grooves of the guns could be left on the projectiles.

Two special hydraulic presses with steam pumps were ordered by the U.S. Treasury Department, one with an 11-inch cylinder, and the other with a 15-inch cylinder, and each having only 1-inch motion. These were very powerful presses and it was said were to be used for printing bank notes, bonds, etc. by a new process, but it probably did not prove satisfactory for the presses were finally discarded.

A paper cutting machine with vibrating knife was made for Mr. John J. Levy for trimming and squaring playing cards in a pile, much the same as books are trimmed. It would not do first-class work, however, for the edges of the cards were not left as smooth as when cut in the ordinary manner.

An order was received from Mr. Robert E. Kelly for a party in Havana, for a press and engraved steel dies to print the covers of cigar boxes, instead of branding them as previously done. We adapted our hand lever press to the purpose, which it suited perfectly, and we afterwards made a considerable number of presses and some very expensive dies. Some of the

presses were very large and powerful, of the fly-press pattern, for printing the covers of packing cases.

During 1863-4 the firm built for Mr. Edward Lloyd, of London, a Two-feeder Rotary Perfecting Press for printing *Lloyd's Weekly Newspaper*. The machine was of double width and printed two copies on a sheet, side by side, from duplicate forms of stereotype plates. The two impression and two type cylinders were all two feet in diameter, and placed in a straight horizontal line, the impression cylinders in the center and the type cylinders, with their inking apparatus, on the outside. The sheets from the two feed-tables were taken alternately by a feeding cylinder, and delivered to the first impression cylinder, and their first side printed, then transferred to the second impression cylinder and their opposite side printed. The sheets from both feed-tables followed the same path through the press, and as they issued, a vibrating switch directed them to the right and left alternately to two sheet-fliers, one at each end of the machine. The cylinders printed a sheet at each revolution, and as it was printed on both sides the product of the press was equal to the product of an Eight Cylinder Type-Revolving Press. But in operating the machine, the 'set-off' gave great trouble and various devices were tried, such as shifting the tympan often, heating the impression cylinder, coating it with oil, etc., but the best remedy was found in finally obtaining a quick-drying low-priced ink. A duplicate of this machine was ordered by Mr. Lloyd some two years later. Patented in the United States, December 1st, 1868, and in Great Britain, January 29th, 1862, No. 239.[74]

Early in 1864 a Bronzing machine was ordered by the United States Treasury Department. The machine was built from the design and under the direction of Mr. S. M. Clark, of Washington. It was to be connected with a cylinder printing

[74] U.S. Patent No. 84,627, issued to Richard M. Hoe and Stephen D. Tucker. The British patent, a communication from Richard March Hoe, was issued to William Edward Newton.

machine, the sheets from which, having been printed with varnish, ran direct into the bronzing machine.

A patent was granted to me, June 28th, 1864, for an inverted or undershot sheet-flier.[75] The 'fly' was placed nearly horizontal, a few inches above the fly-table, with its point inclined slightly upwards. A series of tapes ran just below the fly, and the sheet to be flown ran in underneath these tapes, and was kept up in contact with them by a blast of air directed partly upwards and partly forward. At the proper moment the fly struck the sheet down past the blast pipe onto the fly-table, and as the motion of the fly was very short it would work with great rapidity. This sheet-flier was never used in the United States, but it was patented in Great Britain, November 16th, 1864, and I saw it in operation on the Messrs. Fosters' Type Web Press in the office of the London *Standard*.[76]

A hand operated Paper Cutting Machine was built at this time. It had a guillotine knife that was worked vertically by a screw at each end driven through miter wheels by a hand wheel at one side of the machine. The clamp was worked through similar screws and wheels by a hand wheel at the opposite side. Quite a number were made but the knife worked hard and the machine was in a great measure superseded by the machine worked by power brought out directly after.

In 1865 Messrs. Harper & Bros. ordered a Two Cylinder Rotary Press for printing the type forms of their *Weekly* and *Bazaar*. The machine was made very strong and has 12 form inking rollers. It appears to answer its purpose well, for it is still in use in their office.

An expensive outfit for drilling oil wells was made for Judge A. M. Sherman, of Newburgh, under the directions of his foreman, an old well driller. The drill and other tools were of a new pattern and were expected to work much faster than the old style, but I never heard of them afterwards.

[75] U.S. Patent No. 43,349.

[76] British Patent No. 2,863, issued to William Edward Newton (a communication from Richard March Hoe).

A Pantograph and iron table was made for the New York Phototype Co. This useful instrument for enlarging or reducing drawings, designs, etc., was required to be very accurately made.

Previous to this time the firm had bought four patents for printing subscribers' addresses on newspapers, wrappers, etc., with the result that in 1865, a little apparatus for this purpose was made under a patent granted to Mr. J. A. Campbell, January 27th, 1863.[77] The addresses, in type, were in a galley on a table, and a carriage traveled over this, having an opening in its base large enough to expose an address in the galley. A plunger was fitted to the carriage directly over the opening and operated by a hand lever, the upward stroke of which moved the carriage ahead one address. A folded newspaper was laid over the opening and a stroke of the plunger printed it from the exposed address and moved the carriage ahead to the next address.

A Power Paper Cutting Machine was now built. The guillotine knife has a diagonal cut and is operated by a crank working in a slotted lever, which gives it a slow, strong, cutting stroke, but a quick return. The clamp is worked by a hand wheel through bevel wheels and screws. The iron table has side and back gauges, and is also divided into inches and fractions to facilitate cutting paper to sizes. This is a powerful and serviceable machine, and is still manufactured. S. D. Tucker's patent, October 29th, 1867.[78]

A machine for grinding circular saws was patented by Mr. C. W. Hubbard, February 21st, 1860, which seemed much superior to the machines that the firm was using, so a shop right was bought and new style machines were built in 1866.[79] In the machines made by Mr. Hubbard, the saw was placed on the end of a mandrel on a traveling carriage and grasped between a pair of driving rollers which caused it to revolve slow-

[77] U.S. Patent No. 37,432, issued to James Alexander Campbell, Buffalo, N.Y.

[78] U.S. Patent No. 70,292.

[79] U.S. Patent No. 27,221, issued to Charles W. Hubbard, Pittsburgh, Pa.

ly in front of a grindstone, and as the carriage was moved back and forth, by hand, in contact with the stone, the saw was ground, it being held against the stone by a fixed support behind it. In the machines we built, the travel of the carriage is made automatic, and to suit the size of the saw, and the travel is quite fast when grinding at the center where there is but little surface and quite slow when at the periphery where there is much surface; also the support behind the saw is made to move gradually forward and backward by the travel of the carriage so that a saw can be automatically ground concave, convex or parallel as desired. These machines have been very serviceable, having been in constant use now about 30 years. Improvements patented by S. D. Tucker, December 8th, 1868, and April 27th, 1869.[80]

In 1866 Mr. Andrew Dougherty, of this city, ordered an inking apparatus to be made from his designs and applied to a press in his office. The ink fountain contained two ink rollers, the ink from each roller going to a separate pair of form rollers, the object being to give one half the necessary quantity of ink, in a thinner film, to each pair of form rollers. Mr. Dougherty claimed great benefit from this arrangement and ordered a duplicate apparatus for a press in the office of Messrs. Seibert Brothers, and it was also put on presses subsequently built for him by the firm, but for some reason none were ever made for other parties.

Drawings for a Railroad Coupon Ticket Press were now made and the machine was completed in 1867. The type bed, which is driven by a crank, is geared directly to the impression cylinder through a wheel which has its teeth cut away at a certain point. The bed carries besides the form, a set of numbering wheels for each coupon, and the coupon blank fed to the cylinder is carried around, meets the form and is printed. As the bed and cylinder approach the end of their forward stroke a catch lever catches the cylinder, holds it until the bed

[80] U.S. Patents No. 84,721 and No. 89,448.

has run a short distance on the backward stroke, and then gears it into the bed again, but in a different position from before, so that in the backward stroke the coupon escapes the form but prints from the numbering wheels. At the end of the backward stroke, the catch lever restores the cylinder to its original position with the bed and the coupon is deposited in a box, face upwards. The coupon and its number can be printed in the same or different colors as desired. This press has been so popular that it is still manufactured. S. D. Tucker's patent, December 29th, 1868.[81]

Early in 1867 Messrs. Harper & Brothers ordered from the firm three presses to print the pictorial forms of their *Weekly* and *Bazaar*. Great strength and excellent inking were required for this work, and after due consideration it was decided to build them of the 'Stop Cylinder' style, but modified and improved to suit this class of work. The type bed runs on four tracks and is driven by a crank connected to a wheel which travels back and forth between a rack secured to the bed plate and another fixed to the type bed, similar to the Railway Press. The impression cylinder is driven direct from the bed and its catch lever has a tripping device by which it can be disconnected from its actuating cam and locked to the framework, thus holding the cylinder stationary while the bed is at liberty to run for inking up, etc. The ink is distributed on a table by angle rollers and the form was inked by five single rollers, but was soon after changed to four rollers with distributing rollers above them. These machines were so satisfactory in every respect that a demand for them sprang up at once and the manufacture of the High Stop Cylinder was abandoned, all sizes thereafter being made of this low pattern.[82]

[81] U.S. Patent No. 85,493.

[82] 'The stop cylinder presses invented by Col. Richard M. Hoe, and purchased for our work about 1875, proved a great advance on any presses available up to that time, and the exquisite illustrative work produced in *Harper's Magazine*, *Weekly*, and *Bazar* was largely due to the ability of these presses to turn out work rapidly and satisfactorily.' (J. Henry Harper, *The House of Harper*, New York, 1912, p. 202.)

In 1867 Messrs. Dodge & Blake contracted with R. Hoe & Co. to build one of their patent machines for grinding cutlery, etc., on a cylinder modified to adapt it to grind long saws. A cylinder about 6 feet in diameter, but only 12 inches face, was mounted on a shaft that ran in bearings in an iron frame, and was surrounded by an iron case, leaving a small space between the cylinder and case. Two saws to be ground were attached to the face of the cylinder, at opposite points, by their leading ends, and as they were already tempered they bent freely to its large curve as they revolved with it inside of the case. A large grindstone mounted in front of the cylinder ground the saws through an opening in the case, as they slowly revolved. (Dodge & Blake's patent, July 21st, 1863.)[83] This machine was in use many years until it was superseded by the present system of grinding both sides of the saws simultaneously by passing them between two grindstones.

Mr. George W. Childs now ordered three Four Cylinder Type-Revolving Presses to print the Philadelphia *Public Ledger*, two copies on a sheet, one press to have folding machines attached to fold the sheets to half-page size.[84] The folding machines were made of the usual striking blade style, placed one below each fly-table, and as the sheet-flier laid a sheet on the table it was cut in two by the machine and each copy folded to a half-page size. This arrangement was so satisfactory that folders were soon attached to the other two presses, and also to a Six Cylinder Press ordered shortly after. Patented in Great Britain, December 11th, 1869.[85]

Electrotyping was now fast superseding stereotyping for

[83] U.S. Patent No. 39,317, issued to James Dodge, Waterford, N.Y., and assigned to Dodge & Blake, Cohoes, N.Y.

[84] These presses were installed in the new *Public Ledger* building when it opened on June 20, 1867: 'Three of Hoe's fast presses, with all the latest improvements, will hereafter print the Ledger. . . . Each revolution of the cylinder duplicates each page of the paper, and the addition of a cutting machine to the press to divide the sheets as they pass from the cylinders results in giving two copies of the paper with every revolution of each cylinder.' (*Public Ledger*, June 20, 1867, p. 1.)

[85] British Patent No. 3,582, issued to William Edward Newton (a communication from Richard March Hoe).

most kinds of book and job work, and new and improved devices and machines for more quickly and cheaply producing the plates were being gradually introduced, such as the dynamo for precipitating, the hydraulic molding press, power planing, shaving, sawing, beveling, routing and similar machines. The Blackleading Machine the firm had been making was slow and noisy, so it was modified and simplified into the form in which it is being used at the present time. S. D. Tucker's patent, December 29th, 1868.[86]

A patent was granted on December 10th, 1867, to Mr. R. W. McGowan, of this city, for self-acting or tumbling register points.[87] As this seemed a good invention the firm bought the patent for $500 and at once commenced putting the points on presses. A year or so later Mr. Cyrus Chambers notified R. Hoe & Co. that they were infringing his patent for register points, granted April 5th, 1859.[88] On investigation this was found to be true, and the firm settled the case by paying Mr. Chambers $10 per machine to which these points were applied during the life of his patent.

Messrs. Welsh, Bigelow & Co., of Cambridge, had a few months previous imported from Paris a Flat Bed Perfecting Press, similar to those made by the firm in 1844, but having in addition an attachment by which a set-off sheet was fed to the second impression cylinder to receive the set-off from the sheet then being printed. Both of these sheets were flown by hand, one boy flying the printed sheet and another the set-off sheet. Messrs. W. B. & Co. now gave the firm an order for a similar machine, but to be arranged to fly the sheets automatically, and this machine was completed early in 1868. The set-off sheet was flown inwards towards the set-off feed-table and the printed sheet outwards at the end of the press. A few more

[86] U.S. Patent No. 85,411.

[87] U.S. Patent No. 72,059.

[88] U.S. Patent No. 23,445, issued to Cyrus Chambers, Jr., Philadelphia, Pa., reissued July 21, 1874, No. 5,974. Cyrus Chambers, Jr. (1833-1911) was co-founder of Chambers Bro. & Co., manufacturers of folding machines. (*Nat. Cyc. Am. Biog.*, XXVII, 14-15.)

of these machines were then built, two of them being for Messrs. D. Appleton & Co., but printers generally did not like them and the firm built no others until some twenty years later. R. M. Hoe's patent, April 18th, 1871; patented in Great Britain, August 24th, 1870.[89]

The business of the firm had again outgrown its premises. The business and drawing offices had several years previous been crowded over to the opposite side of Sheriff Street and the machine shop had even spread into the upper story of the carpenter shop, so that more room was a pressing necessity. The firm, in anticipation of extension, had, as occasion offered, bought the balance of property on Sheriff Street from its present premises up to Grand Street, part of this being dwelling houses of no great value, and part had been occupied by a brewery that had now moved away. It was now decided to build on these premises, and accordingly a machine shop 60 feet by 125 feet and five stories high was erected in 1868, and this gave an additional floor space of more than double that of the old machine shop. Many larger lathes, planers, drills and other tools were put in and all machines of a larger class were built in the new factory. The smaller machines and the small parts of the larger ones, together with the saw shop occupied the older factory. The business and drawing offices were moved into the building on the corner of Grand Street, which connected directly with the new factory.[90]

Messrs. Welsh, Bigelow & Co. now ordered a Stop Cylinder Press, to print a class of work having a large absolutely black background. This machine had 12 form rollers, and was ar-

[89] U.S. Patent No. 113,769; British Patent 2,330, issued to William Edward Newton (a communication from Richard March Hoe).

[90] 'One of the great features of the establishment is a "drawing room." The first steps toward the manufacture of every press are taken here, whether it be the smallest "jobber" or the most gigantic ten-cylinder type-revolving machine; and not only is a drawing made of it as a whole, but also of every part, so that if any portion of a Hoe press running in Australia, for instance, should be broken, word may be sent to the factory, the plan of the broken portion hunted up, and the missing part reproduced with the utmost exactness.' (Quoted from the *New-York Daily Tribune* in 'R. Hoe & Co.,' *Printers' Circular*, IV (1869-70), 212.)

ranged with an automatic tripping device which permitted the bed to make one, two or three runs, that is, the form to pass two, four or six times under the 12 form rollers, for each sheet printed. The extra inking was only necessary for special work and was of course obtained at the expense of speed. A similar machine was built the following year for Messrs. Bobbett, Hooper & Co., for printing chromos, and it was said these imitated the original painting so closely that it was extremely difficult to distinguish one from the other.

All lithographic printing was formerly done on hand presses, the impression being taken from the stone by a scraper. Attempts had been made for several years, both in this country and in Europe, to build a suitable machine press for lithographic printing with more or less success. The older attempts generally retained the scraper for taking the impression, but in some of the later ones an impression cylinder was tried with promising result. Mr. R. M. Hoe, who was in Europe at that time, saw a machine of the latter description made by Mr. H. A. [sic] Marinoni, a press builder of Paris, and he was so pleased with its performance that he proposed to Mr. Marinoni that he, as the inventor, should make an application for a United States patent, and for a certain consideration, assign the application to him, Mr. R. M. Hoe. This proposal was accepted and carried out, and a patent was granted to R. M. Hoe, March 16th, 1869.[91] One of Marinoni's machines, and a set of drawings, were sent here for our guidance. It was a stop cylinder press and the bed ran on a six wheel truck and was driven the same as our 'Railway' press. As the stone became thinner from use the stone platform was raised by a screw near each corner until the stone came in proper contact with the impression cylinder. At one end of the bed was an inking table, and at the opposite end a water table covered with felt, to which water was applied by hand from time to time, and this

[91] U.S. Patent No. 87,950, issued to Auguste Hippolyte Marinoni, Paris, and assigned to Richard M. Hoe.

supplied the water rollers for the stone. The sheet was flown by a delivery cylinder with tapes leading to a sheet-flier. This press was put in operation here, but it soon became evident that it was entirely too lightly built for its work.

In building our machines we adopted our latest stop cylinder style as far as possible. The bearings of the impression cylinder have a slightly elastic packing above them, so that by yielding a trifle it will prevent a stone from breaking in case its surface should be a little uneven. A water fountain and rollers automatically dampen the stone, and if desired, the bed can make two runs to each sheet printed. This machine was built in 1868 and put in operation early in 1869, and at once became a great favorite with the trade and so remains to this day. Marinoni's sheet delivery arrangement was an improvement on any previously made and was adopted by the firm on both lithographic and typographic machines.

The firm's business with Great Britain had gradually become so large and important that, at the solicitation of many of its customers, a small repair shop had been started for their convenience in 1865 in Crown Court, Salisbury Square, London. But the increase of business had outgrown this place, so Mr. R. M. Hoe now leased a convenient factory in Tudor Street, Whitefriars, that would accommodate 75 to 100 workmen and furnished it with a fine stock of tools. Manufacturing was now also begun in a small way and a branch office was opened with Mr. Conquest as agent and manager, a position which he filled with great ability and fidelity until his death in 1887.

In 1868 a new, wide street called 'Broadway' was opened in South Boston, and ran directly through our factory, completely destroying it. As there was now ample room in the new factory building just completed here, it was decided that instead of taking other premises in Boston it would be more economical and convenient to have the works in New York, and they were accordingly brought here early in 1869.

It is well known that the quality of steel in saw plates, espe-

cially in circular plates, is far inferior to that used for wood-cutting tools, with the result that teeth cut in such plates require frequent sharpening and cause great loss of time by the stoppage of the saw for that purpose. It had been sought to remedy this by inserting in the saw plates teeth made from steel of the proper quality, but the expense of inserting such teeth had hitherto been so great that it had not been extensively adopted. Patents were granted to Mr. W. P. Miller, October 9th, 1866, and September 1st, 1868, for an improved method of inserting teeth in saw plates which consisted of making the sockets in the plates a portion of a true circle with 'V' shaped edges, and the teeth to have a circular base with grooved edges to fit tightly in the sockets.[92] By this method the sockets and teeth can be fitted together almost entirely by machinery, and, of course, accurately and cheaply. As this seemed a good invention, and was directly in the line of the firm's business, an interest was bought in these patents in 1869, and the necessary machinery and tools were at once gotten up for making the saws. The sockets and teeth were all made to standard gauges, so that the worn-out teeth could be quickly taken out and new ones inserted without any fitting whatever. The teeth were made of an excellent quality of steel and the saws were well liked by the trade. The manufacture of them increased notably the business of the saw department.

The little newspaper addressing apparatus which the firm had been making for several years past was now superseded by one made under a patent granted to Messrs. N. E. and G. W. Warren, April 4th, 1865, and assigned to R. Hoe & Co. in 1869 (Plate XX).[93] In this machine, the addresses in type, are in a galley, which runs in a groove in a table, and is moved ahead one address to each stroke of a hammer operated by the foot. A shield covers the galley, but it has an opening directly

[92] U.S. Patent No. 58,664, issued to Warren P. Miller, San Francisco, Cal., and U.S. Patent No. 81,811, issued to Warren P. Miller, New York, N.Y.

[93] U.S. Patent No. 47,142, issued to N. E. Warren, Cleveland, Ohio, and G. W. Warren, Hillsdale, Mich.

under the hammer, through which, as the galley travels, the addresses are exposed, one at a time. A folded newspaper or wrapper is laid over the opening and the hammer prints it from the address exposed, and moves the galley ahead one address. This is a convenient arrangement and is the form in which the machine is still built.

A patent was granted to Mr. R. M. Hoe and myself, June 29th, 1869, for a web press in which type and impression cylinders were arranged in two vertical series facing each other, one series consisting of one type cylinder between two impression cylinders, the other series of one impression cylinder between two type cylinders.[94] Thus a web passing between the upper pair of cylinders of each series would be printed on both sides, and a second web simultaneously passing in the opposite direction between the lower pair of cylinders of each series would also be printed on both sides. By the addition of another type and impression cylinder a third web could be printed and by adding still another type and impression cylinder a fourth web could be printed, and so on. The blankets on the impression cylinders were endless webs of considerable length so as to lessen the effect of the set-off. This seemed a very simple arrangement, but when the inking and other details were filled in it was seen to be very cramped and inconvenient for working, and as the factory was then filled with orders for type-revolving and other machines nothing further was done in the matter. Patented in Great Britain, July 12th, 1871.[95]

A patent for a bronzing machine was granted to Mr. G. H. Babcock, October 25th, 1859, and a patent for the same object was granted to Mr. J. F. Tapley.[96] As there seemed a demand

[94] U.S. Patent No. 92,050.

[95] British Patent No. 1,825, issued to William Edward Newton (a communication from Richard March Hoe).

[96] U.S. Patent No. 25,874, issued to G. H. Babcock, Westerly, R.I. Biographical information about George H. Babcock (1832-1893), engineer and inventor of printing presses, is in *Nat. Cyc. Am. Biog.*, V, 304-5. J. F. Tapley, Springfield, Mass., was granted two patents for bronzing machines: U.S. Patent No. 41,029, December 22, 1863, and U.S. Patent No. 71,085, November 19, 1867.

for a bronzing machine and as there were some good points covered by these patents the firm bought them and in 1870 brought out an improved machine. A prepared sheet was fed to a revolving cylinder and received a line of bronze powder from a reservoir. This was spread over the sheet by vibrating pads, the superfluous bronze was cleaned off by revolving brushes and caught in a receptacle, and the sheet laid down by a sheet-flier. It was important that the machine should be as near air-tight as possible so that no powder should escape, and it was also requisite that both sides of the sheet should be quite clean. Quite a number of these machines were built, but they seemed to give more trouble than profit, and as other makers of them appeared, the firm decided to give its attention to objects of more importance.

It was thought it would improve the quality of the printing if the constantly varying motion of the type bed of a printing machine driven by a crank, could be somewhat equalized, and a patent for that purpose was granted to Mr. R. M. Hoe and myself, November 1st, 1870.[97] In applying this to a stop cylinder press, the axle in the bed driving wheel to which the connecting rod from the crank is attached, is put eccentrically in the wheel, and the wheel is placed in such a position in the press that when the crank is at half stroke the axle is directly above the center of the wheel. This will decrease the speed of the bed at that point and increase it correspondingly as the crank approaches the termination of its stroke, thus in a measure equalizing its motion. But this arrangement necessitates a longer crank, which increases the height of the press, and that was objectionable, besides printers said the printing from the existing method was quite satisfactory, so nothing further was done in the matter.

Early in 1871, The American Phototype Relief Printing Co., of Philadelphia, ordered a powerful hydraulic press for mechanical printing from its plates. The ram of the press was

[97]U.S. Patent No. 108,785.

18 inches diameter, but was required to raise only one half inch. The press was tested at our standard of 10,000 lbs. per square inch, which gave a working pressure of 1,270 tons, and was by far the most powerful press the firm had yet built. It was reported that the method of printing was not a success, but however that may be, we made no other similar presses.

It had been decided to build, as fast as orders in the factory would permit, a Four-Feeder Rotary Perfecting Press, on the same plan as the Two-Feeder Perfecting Presses previously made for *Lloyd's Weekly Newspaper*, of London, and most of the drawings and patterns for it had been made during 1869 and 1870. In April, 1871, an order was received from the *New York Daily News*, for a Four-Feeder Perfecting Press to print the *News* four copies on a sheet, the sheets to be flown open, and as the new press was of the proper size it was decided to complete it for this order. Bearing in mind the trouble experienced in the set-off of the ink in the Two-Feeder Perfecting Presses, the second impression cylinder of this machine was made four times the diameter of the type cylinder, thus enabling it to receive four times the quantity of set-off before changing tympans. The four feed-tables faced each other in pairs one above the other, and all the sheets passed through the machine in one common channel, thus there was a space of only a few inches between succeeding sheets and this made necessary a different method of flying them from any heretofore used. This was accomplished by adopting a plan devised by Mr. R. M. Hoe and myself in 1853, and known as the 'long and short path.' By this device two successive sheets in their passage to the sheet-flier, were separated into two different paths of such relative lengths that when the sheets met again they issued one upon the other. Two sheet-fliers were placed back to back and the pairs of associated sheets were directed to each alternately, by which they were laid down to right and left. Patented, September 10th, 1872.[98] The speed of this ma-

[98] U.S. Patent No. 131,217, issued to Richard M. Hoe and Stephen D. Tucker.

chine was only limited by the ability of the feeders to supply these large sheets, which was about 8,000 per hour, and it did excellent duty in the *Daily News* office for many years.

It had always been the practice of the firm to dispose of its older machines and tools and replace them with the best obtainable, and also to introduce all new styles of tools, from home or abroad, that seemed advantageous for this class of work. Many special tools were made to finish the smaller parts of the various machines manufactured, to expedite and cheapen their production. The various shops were well heated and ventilated and otherways made comfortable for the workmen, and it was the policy of the firm to employ the better class of men and the most skillful mechanics and pay them accordingly, being convinced that they were the most satisfactory and in reality the cheapest workmen. As a consequence, good mechanics always sought employment in the factory and remained there, and R. Hoe & Co.'s works became noted as one of the best equipped in mechanics and tools in the country.

Evening school for the firm's apprentices, six months in the year, has been established for many years, and the good results have been so encouraging that great interest is taken in it. The school room is well supplied by the firm with suitable books and appliances and competent teachers are employed. Each boy attends two evenings a week and quits those evenings one hour earlier. They are instructed in the various branches of a common English education according to their needs and capabilities, and those who are sufficiently advanced are also taught mathematics and mechanical drawing. Many of the boys make rapid progress, and some of them in after years express the great advantage they have since derived from their apprenticeship studies.

The firm had now turned its attention again to a continuous sheet or web printing machine. The success of the flexible matrix for curved stereotyping made the printing part of a web machine perfectly feasible, and cutting the sheets from

the web presented no difficulty, but the great obstacle to complete success in web printing was in disposing properly of large size sheets printed at great speed. The Bullock Co., of Pittsburgh, was trying to introduce a machine in which the printed sheets were seized by grippers on leather belts and deposited on a fly-table as they traveled over it. The London *Times* had built in its own office the Walter Press in which the sheets were partially thrown to the right and left alternately by an oscillating sheet-flier, as shown in Beaumont's patent of 1853, (owned by R. Hoe & Co.) but which required an assistant at each table to straighten the sheets out. The Victory Co., of Liverpool, had built a machine in which the sheets were folded by the usual vibrating blades. Messrs. Bond & Foster, of Preston, were bringing out a Double Type-Revolving Press, each press printing one side of a web in the precise manner claimed in the above cited Beaumont patent of 1853, but all of these machines fell far below our adopted standard of speed for a web machine, of 200 eight-page sheets per minute.

In 1871 Mr. R. M. Hoe, who was then in Europe, received an order from Mr. Edward Lloyd for a web press to print *Lloyd's Weekly Newspaper*. This machine Mr. Hoe decided to have built in the London factory, and also intended to fold the sheets by blasts of air, but he returned to New York in 1872 and wished me to go to London to complete it. When in London Mr. Lloyd told me he would prefer his papers delivered not folded, and the publishers of several of the principal daily newspapers said the same, because a large proportion of their editions were sent into the provinces, and it was more convenient and cheaper to send them in bulk unfolded. I therefore built for the machine an apparatus we called a 'collecting cylinder,' devised by Mr. R. M. Hoe and myself in 1853 for the special purpose of flying the sheets from a fast running web press. In this apparatus, six, or any predetermined number of successive sheets, are collected on a cylinder and then switched off in a body to a sheet-flier which lays them on a table. Pat-

ented in Great Britain, August 28th, 1872.[99] Patented in the United States, June 26th, 1877.[100] This apparatus was applied to Mr. Lloyd's machine in 1873, and operated so satisfactorily, flying 8-page sheets at a speed of 12,000 per hour, that the London *Telegraph* at once ordered eight web machines, and the London *Standard* six machines. The *Telegraph's* machines were built in New York, while the *Standard's* were built in the London factory, which was sufficiently large for the purpose, and this started manufacturing there in a business-like manner. These orders were followed by others, for the *New-York Daily Tribune*, *Cincinnati Commercial*, *Sydney Morning Herald*, etc., showing the Newspaper World's appreciation of our machine (Plate XXI).

I had intended using in the cutting cylinders of these machines the peculiar form of stationary knife devised for the web cutting and folding machine built in our experiment room in 1858, but found that it had since been patented in the United States by Mr. William Bullock. It was held in the Patent Office that, as we had never applied for a patent, nor put it into practical use, we had forfeited our right to it, and that Bullock's patent was valid. However, I devised a jumping knife that we used in machines in the United States until Bullock's patent expired in 1880, and then substituted our own knife, which, with a modification of the springs, we are using in our machines today.[101] Patented August 8th, 1876.[102]

In designing these new machines I made a radical departure from our customary styles by dispensing with all moldings, ribs, etc., as far as possible, and making the members of the framework rectangular in section with all corners rounded.

[99] British Patent No. 2,561, issued to William Edward Newton (a communication from Richard March Hoe).

[100] U.S. Patent No. 192,510, issued to Richard M. Hoe and Stephen D. Tucker.

[101] Bullock's previously noted patent was issued in 1863. In 1861, the term of a patent was extended from 14 to 17 years and the power of the Commissioner of Patents to extend patents was withdrawn. (*The Story of the United States Patent Office*, Washington, D.C., 1961, p. 11.)

[102] U.S. Patent No. 180,966, issued to Stephen D. Tucker.

The various brackets, arms of wheels, and smaller parts, were of a similar form or oval. This gave the machine a massive and strong appearance, although in fact some of the parts were hollow where no great strength was required. This style seemed to meet with favor, for it was at once adopted for our Stop Cylinder and Lithographic Presses, and soon extended to the various cylinder presses, and a host of other machines built by the firm, and has since been almost universally copied by the firm's competitors.

The principal business office of R. Hoe & Co. had been in Gold Street for fifty years past, but business offices were now gradually going further up town, and printing offices were also beginning to move up, so it was decided to put a large building on the corner of Grand and Sheriff Streets, for offices, warerooms, drawing office and light manufacturing, and also to establish there the principal business office and eventually to move up the entire Gold Street works. Accordingly, during 1873 a building fifty feet by eighty-eight feet was erected, seven stories high with a wing connecting it to the factory, and the Gold Street office gradually settled in it.

The trade was constantly calling for larger cylinder presses and these required racks of such a length that our rack cutting machine, which had been in use some twenty-five or thirty years, had become too small, so in 1871 drawings were made for an improved machine. This new machine was arranged to hold the racks stationary, and move the cutter-head along, by means of a screw, to lay off and cut the teeth of the racks to the various pitches required, and the plan was so well liked that the machine was commenced at once. We knew there was no screw in the works sufficiently accurate to give the pitch divisions with the precision we desired, but supposed one could be obtained while the machine was being built, but after much time spent in making enquiries we could find no one, either here or in England, who would agree to make a screw guaranteed to suit our requirements for accuracy. Now, measures

of length of great precision, copied from the British Government Standard, were obtainable, and Messrs. Darling, Brown & Sharpe and others were then making such measures divided with great accuracy, so I decided in 1874 to abandon the screw for the partly finished machine, and substitute a stationary rack in connection with a traveling worm or tangent-screw attached to the cutter-head, to obtain the pitch divisions. We then prepared two steel bars 1 by ⅝ inches and 15 feet long, one of which was sent to Darling, Brown & Sharpe and the other to the United States Coast Survey at Washington, with directions to divide one side of the bar into inches and the opposite side into centimeters, the divisions to be made with all the care and accuracy possible, and the lines to be as fine as consistent with visibility. Upon examination of the bars after division, the one divided by Darling, Brown & Sharpe was found to be far the better, in fact its few errors were scarcely discoverable. The bed of the machine was fitted up with its traveling cutter-head in proper working order and two rack blanks 11 feet long (one for a future machine) were clamped together on the machine in position to be cut. The steel bar divided by Darling, Brown & Sharpe was secured to the bed of the machine and an index arm, carrying a three inch D. B. & S. graduated steel rule at its point, was so attached to the cutter-head that the rule was held just in front of, and very close to, the steel bar. The cutter-head was then so set that the division lines on the rule and on the bar, seen through a microscope, exactly coincided, and a cut was made across the rack at the proper angle to suit the thread of the tangent-screw, and in this manner the racks were toothed ½ inch pitch from end to end. This was an exceedingly delicate and tedious operation, occupying about three months, for not only were the racks allowed to cool after each cut, but the temperature of the room was also taken into account. Notwithstanding all this care, the divisions of the racks were not absolutely perfect, but the inaccuracies, slight as they were, were corrected by dress-

ing off the faulty teeth until they were as nearly perfect as the most skillful workman could make them. One of the racks thus produced was fitted in place in the machine, and a bronze tangent-screw, 3 inches diameter, 12 inches long and ½ inch pitch, was mounted in a box and secured to the cutter-head in proper position to gear into the rack. A grooved shaft extending the length of the machine runs through the screw and drives it to move the cutter-head and itself laterally by means of a feather working in the groove, and the shaft is operated through the usual change wheels and index crank to give the cutter-head the proper travel for cutting racks of the various pitches required. The work produced by this machine has given great satisfaction.

A patent was granted to Mr. W. P. Miller, May 19th, 1874, in which the cutting point of the inserted saw tooth heretofore described, is entirely removed, and a slot is cut in that part, into which a small cutting chisel, called a chisel-bit, is inserted, so that the former tooth has now become merely a chisel-bit holder.[103] This method has been modified by a patent of October 5th, 1875, in which the chisel-bit is laid in a recess cut in the curved periphery of the holder, and carried by it into the circular socket in the saw plate, where it is firmly held, and this is the method in use at the present time.[104] These chisel-bits are very inexpensive, and when worn out can be removed and replaced by a new set in a few minutes' time.

Although all the web machines we had built thus far had delivered the sheets unfolded, yet as all newspapers required to be folded whether delivered to the public by carriers or by mail, the firm was convinced that newspaper proprietors would favor a machine that would print and fold the sheets simultaneously without a reduction of speed, as that evidently would be to them a great saving of time and expense. To accomplish this I devised in 1874 a rotating cylinder for transverse fold-

[103] U.S. Patent No. 151,043, issued to Warren P. Miller, New York, N.Y.
[104] U.S. Patent No. 168,338, issued to Warren P. Miller, New York, N.Y.

ing, which on trial operated perfectly. Patented in the United States, December 14th, 1875, and in Great Britain, September 4th, 1875.[105]

In 1875 the firm received an order from the *Glasgow Herald* for two web machines to print and deliver eight-page sheets folded to one quarter page size at the rate of 12,000 per hour. The sheets were first folded transversely by the rotating folding cylinder, and then switched alternately into two separate paths, and received their subsequent folds by vibrating blades. These machines gave great satisfaction, and from that time forth practically all web machines built by the firm folded the sheets.[106]

The firm now bought Mr. W. H. Chandler's patent of March 30th, 1869, for 'discharging fingers' on an impression cylinder of a printing machine.[107] These fingers are arranged to lie under the front edge of the printed sheet, and at the proper time to lift it up to aid in conducting it off the cylinder, thus dispensing with the tapes formerly used around the cylinder for that purpose. This device is still used on some of our flat-bed presses.

At the Centennial Exhibition in Philadelphia in 1876, the firm made a display of some of its more important products, such as a web printing and folding machine, a web machine that delivered its sheets unfolded, a double cylinder, two-revolution cylinder, stop cylinder and lithographic printing machines, large circular saws with inserted teeth and a variety of minor articles (Plate XXII). The web printing and folding

[105] U.S. Patent No. 171,196; British Patent No. 3,105, issued to William Conquest (a communication from Stephen Davis Tucker).

[106] 'The defects noticeable in the Bullock press and in rival rotary machines, then made by Walter of the London *Times* and by Marinoni of Paris, were fairly overcome in a new form of rotary machine first known as the web press, made by R. Hoe & Co., and first used by the *Tribune* in 1871 [sic], which printed from plates stereotyped in the curve at the rate of ten or twelve thousand copies in an hour, and piled the printed copies, counted and folded, ready for instant delivery. Its high speed was not its only merit. Feed-boys and fly-boys, counters and folders, were needed no more, and their withdrawal was a relief to the overcrowded pressroom.' (Theodore L. De Vinne, *Printing in the Nineteenth Century*, New York, 1924, pp. 9-10.)

[107] U.S. Patent No. 88,448, issued to William H. Chandler, Winchester, Mass.

machine was built for the *Philadelphia Times*, and was in operation daily, printing and folding a four-page sheet of the *Times* at a speed of four hundred sheets per minute, and was always a center of attraction in the Exhibition. In the competitive trials of web machines, it ran at nearly five hundred sheets per minute and far surpassed, in both performance and speed, all its competitors. The whole exhibit was much admired and received the highest award of its class, a medal and diploma, and added to the prestige of R. Hoe & Co.[108]

A Steel plate printing machine was now built for Mr. Robert Neale from his designs, and quite different from his former one.[109] It was a stop cylinder machine in which the sheets were fed to the under side of the stationary cylinder, and as this made but one revolution, it stopped in a position convenient for removing the sheets by hand. The bed was driven by a mangle wheel having external and internal teeth into which an oscillating pinion worked alternately, thus giving the bed a reciprocating motion. The arrangement for inking, wiping, and polishing the plate, was said to be very effective, and the machine was set to work in the office of Messrs. D. Appleton & Co., Brooklyn.[110]

The last Type-revolving press built was a four cylinder machine, ordered by the Methodist Book Concern in 1876, to print the *Christian Advocate* in sixteen-page form.[111] It was ar-

[108] A description of this exhibit is in Jessie E. Ringwalt, 'Exhibition Reviews,' *Printers' Circular*, XI (1876-77), 177-178.

[109] U.S. Patent No. 162,677, April 27, 1875, issued to Robert Neale, Brooklyn, N.Y.

[110] In 1878, the Neale-Appleton press and another plate printing press, the Milligan press, were placed in operation on trial in the Bureau of Engraving and Printing. After finding that 'the presses were suitable for printing certain classes of work in a satisfactory manner with a considerable savings to the Government (the Milligan type more so than the other),' the Bureau offered to construct five additional machines of each type at $500.00 per press and royalties of $1.00 per 1,000 impressions. 'Owing to disharmony between the owners of the Neale-Appleton press, the proposition was not accepted by them and, consequently, no further use was made by the Bureau of that machine.' (*History of the Bureau of Engraving and Printing*, Washington, D.C., 1964, p. 32.)

[111] The Methodist Book Concern paid $15,000.00 for this press. (Stephen J. Herben, 'The Printer's Story—1826-1926,' *Christian Advocate*, CI (1926), 1115.) It was installed in December, 1876, and first used for the January 4, 1877, issue of the *Christian Advocate*. (Letter from Mr. Gordon B. Duncan, January 13, 1972.)

ranged with a combined collecting and folding cylinder and a pasting apparatus at each end, by which the sheets, after their first sides were printed, were collected on the cylinder and flown, and after their second sides were printed they were pasted in the proper margins, folded to page size and piled on a table. This was the first press built by R. Hoe & Co. which pasted the sheets for folding, and it was continued in use until superseded by a web machine in 1890.[112]

During 1877 over a dozen patents were granted to me, all relating to web printing and delivering mechanisms. A patent dated July 10th, 1877, was for an accelerating delivery cylinder, by which the speed of the successive sheets, as they ran from the cutting cylinders to the delivery mechanism, was accelerated, and a space gained between them for the entrance of switches, fingers, etc.[113] A patent granted May 29th, 1877, was for a combined collecting and folding cylinder with pasting devices, whereby two or more sheets were collected on a cylinder, pasted, if desired, and folded off in a body, or switched off to a sheet-flier.[114] A patent dated June 12th, 1877, was for a pair of cooperative cutting and folding cylinders that cut the sheets from a web and folded them transversely.[115] A patent granted November 27th, 1877, was for a collecting cylinder designed more particularly for collecting on its circumference two, three or more duplicate sets of small sheets as for books, pamphlets, etc.[116] Each set may consist of, say, a dozen sheets, more or less, which will be collected in numerical order, and the sets may be folded off in succession, or may be switched off unfolded. Also there may be a series of sets of sheets in the length of the cylinder, in which case these series need not be cut apart until they leave the cylinder.

[112] The Methodist Book Concern paid $20,000.00 for this press. (Herben, 'The Printer's Story,' p. 1115.)

[113] U.S. Patent No. 192,954.

[114] U.S. Patent No. 191,494.

[115] U.S. Patent No. 192,034.

[116] U.S. Patent No. 197,700.

A Mr. Phelps now gave an order for a No. 7 Hand Cylinder Press to be fitted with a two-color printing attachment from his design. Two ink fountains and rollers for different colors were placed close in front of the impression cylinder, the form rollers of which were made to rise and fall separately by means of friction rollers on their shafts running on bearers on the type beds. The face of these bearers was so shaped as to cause the form rollers to drop and ink certain lines of type in the form as required, and then lift to escape inking the other parts, thus a sheet would be printed in two colors at one impression. The machine ran very well at a slow speed in the factory, but for some reason Mr. Phelps never took it away, and although it was shown to printers generally, none favored it, and it was finally dismantled and sold.

Just at this time the firm bought of Mr. E. L. Ford his invention of 'Duplex Printing-Machine and Folding Apparatus Combined,' and the patent dated September 11th, 1877, was issued to R. Hoe & Co.[117] This mechanism prints a main web and a supplement web simultaneously on independent machines, gives them a line of paste where required, cuts them into sheets, brings a sheet from each web together in the folding apparatus, and folds them up as a single product. The supplement sheet may be of the same size as the main sheet and they will then meet and be folded together, or it may be any smaller proportion of the main sheet, and it will then meet the main sheet, which has been previously partially folded, and the folding be completed, or the main sheet may be printed in book form and folded small as a pamphlet, and a small supplement sheet meet and receive one fold with it, thus forming a cover to the product.

It was observed that the wheels on the large impression cylinders of the web presses ran as if they were in some way out

[117] U.S. Patent No. 195,115, issued to Edward L. Ford, New York, N.Y., and assigned to R. Hoe & Co. Edward Lloyd Ford, partner in the publishing firm of J. B. Ford & Co., died, aged 36, in 1880. (John R. Howard, *Remembrance of Things Past*, New York, 1925, p. 215; *New-York Times*, December 18, 1880, p. 5.)

of truth, and an examination showed that the teeth were not equally divided, and the fault was traced to the Whitworth Wheel-Cutter by which they were cut. Messrs. Whitworth & Co. were written to in the matter and they replied in effect that they were aware their dividing wheel was not perfectly accurate, but thought it sufficiently so for all practical purposes; however, they intended to make a new wheel in the near future and would then send us a duplicate cut from it. When this duplicate arrived a year or two later, it was found to be quite as defective as the wheel we were using and it was at once sent back, and this was so discouraging that in 1877 we decided to make a new wheel ourselves. Several plans were proposed for it, but it seemed to me that the most accurate and feasible one was to place a given number of duplicate blocks around the periphery of a wheel of such size that they would just encompass it, and use this, with its sections, as a master wheel to tooth a working dividing wheel. For this purpose a lot of cast-iron strips were planed up ¾ inch by ¼ inch and cut up into 180 pieces a little over an inch long, and a hole drilled through each to screw it fast. These pieces were fitted, as to length, in a gauge with the greatest possible accuracy so that all were exactly of one length, and their ends were radial so that each piece was really a segment of two degrees of a circle, and when placed end to end they formed a circle of about five feet diameter. A new wheel was fitted to the arbor of the Whitworth Wheel-Cutter and a flat recess ¼ inch deep turned in on one side of its rim to receive the 180 segments. The bottom of the recess was primarily made a trifle greater in diameter than the circle formed by the segments, and was then gradually reduced until the segments surrounding it just made end to end contact. This was an operation requiring great skill and patience, but was very successfully accomplished. Each segment was pressed to the bottom of the recess by a separate clamp on the periphery of the wheel, and likewise secured to the side of the recess by a screw through its central hole, thus each one could

be removed without disturbing its neighbors. This wheel is used only for dividing other wheels and similar work, and when so used it is put on the arbor of the Whitworth Wheel-Cutter in place of the ordinary dividing wheel and two sliding stops with tapering points that will accurately fill the tapering space left when a segment is removed, are arranged at diametrically opposite points of the wheel's periphery. Two opposite segments are taken out and the points of the sliding stops inserted in their respective vacancies and a cut made in the wheel being divided. Now the operation of cutting will heat, expand and distort the wheel, so the next cut should be made at a distant point, say directly opposite, and then at the quarters and so on, but if the greatest accuracy is required, the wheel should be allowed to cool between each cut. All the dividing wheels on the wheel cutters in use in the factory up to a late date were divided by this wheel. It was undoubtedly the most accurate dividing wheel in the country and in all probability has no superior to this day.

A machine was built for Messrs. Raynor & Bro., veneer sawyers of this city, from their drawings, for shaving veneers from a log instead of sawing them, for they said at least one-quarter of the wood was lost in sawing. This was a massive, strong machine that would take in a log eight feet long, and was erected in their mill, and after some little trouble it was said to work very successfully.

In 1878 a Type setting and distributing machine combined was built for Mr. Joseph Thorne from his drawings. It was composed of two cylinders of about fifteen inches in diameter and twelve inches long, having many longitudinal grooves cut in their peripheries for receiving type. These cylinders were placed on end, one above the other, the lower one being stationary, while the upper one revolved intermittingly. The type to be distributed was put in the grooves of the upper cylinder and, during its stoppages, they were dropped down into their proper grooves in the lower cylinder, the entrances to which

conformed to the shape of their respective types, and from thence the type was taken as required and set up in line by the operator at the key-board. The machine seemed quite simple in principle, and I have heard that quite a number have been made since, but they require to be kept very accurately adjusted, and I do not think that they have ever become very popular.[118]

In 1878 the firm bought of Mr. Luther C. Crowell all his patents and applications for patents for inventions in printing and folding machines, and also engaged his services for a term of years to aid in developing such machinery.[119] In Mr. Crowell's patent of August 22nd, 1876, for folding paper, the printed web is slit longitudinally into two narrow webs, and these can be cut transversely into, say, four-page sheets and folded separately, or one part of the web may receive a line of paste and, by passing around a triangular device, be transferred under the under part, and the two associated webs be cut transversely and the sheets folded up together, forming eight-page sheets of four open leaves.[120] The patent of January 16th, 1877, shows a pair of combined cutting and folding cylinders which will cut a web into sheets and fold them once transversely and deliver them, or will fold them twice transversely, and then once longitudinally by a vibrating blade and once by a rotating blade, and deposit them in a trough.[121] There is also a device by

[118] The *Am. Dict. Printing and Bookmaking*, p. 540, states that the Thorne typesetting and distributing machine was 'used in many offices in England and America.' U.S. Patent No. 232,157, September 14, 1880, issued to Joseph Thorne, Port Richmond, N.Y. A short biography of Joseph Thorne (1826-1897) is in *New York Times*, May 5, 1897, p. 9.

[119] The biography of Luther Childs Crowell (1840-1903) supplies additional information: 'In 1875 he placed in the press-room of the Boston "Herald" the first machine by which a folio or quarto-paged newspaper could be printed double, cut and pasted from a continuous roll. This machine occasioned several claims for priority of invention, and resulted in an action at law for infringement brought by the firm of R. H. [sic] Hoe & Co. of New York and London, which was one of the largest interference cases before the patent office at that time (1879). Messrs. Hoe & Co. were compelled to purchase Mr. Crowell's patents, and realizing his inventive genius, at the same time they engaged his services as superintendent.' (*Nat. Cyc. Am. Biog.*, XIII, 604.)

[120] U.S. Patent No. 181,250, issued to Luther C. Crowell, Boston, Mass.

[121] U.S. Patent No. 186,309, issued to Luther C. Crowell, Boston, Mass.

which a sheet can be cut into halves for supplements. The patent of February 18th, 1879, is for a printing machine which has but one type cylinder and one impression cylinder.[122] The forms to print one side of the web cover one-half of the type cylinder in its length, and the forms for the other side of the web cover the opposite end of the cylinder. The width of the web is half the length of the printing cylinder, and as it passes through between them it is printed by the form at one end of the cylinders. It then runs over a device same as shown in the patent of August 22nd, 1876, by which it is turned over and transferred to the opposite end of the cylinders between which it again passes and has its second side printed. A second impression cylinder is shown operating with this same type cylinder, whereby a second web can be printed in the manner above described simultaneously with the first one. Or the type cylinder may be sufficiently large in diameter to take on the forms for printing both sides of the web, and in that case the length of the cylinders need only be sufficient for one width of the web, and after the first side of the web is printed it will be turned over, without being transferred laterally, by a device shown in the patent, and will be timed to be properly backed on the same forms by the second impression cylinder. This patent also shows a supplement web that has been previously printed and rolled up. This web can be automatically cut into full size or half size sheets and fed in with the main sheets and folded up with them. Mr. Crowell's patent of July 1st, 1879, is a very important one.[123] It is of the same general design as the patent of January 16th, 1877, except that the first longitudinal fold is here given by a rotating blade, instead of a vibrating one. This patent has a broad claim for a combination of rotating web printing, cutting and folding, which has been of great benefit to the firm.

[122] U.S. Patent No. 212,444, issued to Luther C. Crowell, Boston, Mass., and assigned to R. Hoe & Co.

[123] U.S. Patent No. 217,071, issued to Luther C. Crowell, Boston, Mass., and assigned to R. Hoe & Co.

In 1879-80, a Type-revolving and web press was built for the New York *Commercial Advertiser*. At that date, stereotyping the forms of a large folio newspaper was a more expensive and a much slower process than today, and time is of first importance to an evening newspaper. This machine printed two rolls or webs of paper simultaneously. The type forms for the outside pages and inside pages were placed respectively on opposite sides of a large revolving central cylinder which was surrounded by eight impression cylinders, a set of four at each side, and each set printed a separate web. One side of each web was printed from these forms by the first two cylinders of the sets in the precise manner shown in Beaumont's patent of 1853, assigned to R. Hoe & Co. The webs were then turned over by a device shown in Mr. Crowell's patent of February 18th, 1879, and their opposite sides printed from the same forms in proper order by the last two cylinders of the sets, and were then cut into sheets and flown. Quite a number of type web machines of various styles were built during the next few years, some of which printed and folded, four, eight and even twelve page sheets, but they were mostly one roll machines. Several two roll machines were built to print and fold four, eight and twelve page sheets at the rate of twenty-four thousand per hour, for evening papers of large circulation, but their complication caused such stoppages and annoyance that their use was abandoned. During these years the stereotyping process was being steadily perfected and time shortened; this and the facility with which stereotype plates for various editions could be changed on the press with only two or three minutes loss by stoppage, were all advantages that gradually induced the evening papers to adopt stereotyping and the ordinary web press.

An order was received from the *Saint Louis Republican* for a web machine to print, paste and fold that paper at a speed of 22,000 eight page sheets per hour. The web was of double width, or four pages wide, and was slit lengthways centrally,

and then cut transversely at page length into four page sheets, the alternate ones of which received a line of paste. These sheets were collected in pairs and folded longitudinally by striking blades, thus forming eight-page sheets of four open leaves, pasted at the center margin, and to be further folded as desired. The four-page sheets were flown unfolded at a speed of 44,000 per hour, and the eight-page sheets also at 22,000 per hour. This was the firm's first web machine that pasted the sheets.

In 1880 the firm bought of Messrs. Anthony & Taylor of England, a certain interest in their two British patents dated respectively March 27th, 1875, and August 31st, 1875, and also their entire rights to all United States patents that might be obtained containing the inventions and devices covered by the British patents, and finally bought their remaining interests in said patents.[124] These British patents described (1) bars placed obliquely, and a combination of such bars with rollers, for changing the course of a web of paper, for turning it upside down, for shifting it sideways, for slitting it lengthways and bringing one part under the other, etc. and (2) utilizing these manipulations of the web to accomplish certain results in its printing and delivery. Many of these results had previously been attained in the United States but had not been patented in Great Britain, hence in view of the firm's increasing business with that country, these patents were desirable.

Heretofore, in folding a running newspaper web without reducing its speed, the first fold had always been made transversely, but it was very desirable that its first fold could also be a longitudinal one. A device for folding longitudinally a running web of cloth, paper, etc., was patented by Thomas Thompson of Niversville, N.Y., in 1856.[125] It consisted of a long triangular shaped 'forming block' placed nearly upright with its apex downwards, and as the web ran over it from its

[124] British Patents No. 1,127 and No. 3,056, issued to Edwyn Anthony and William Wilberforce Taylor.

[125] U.S. Patent No. 14, 260, February 12, 1856.

broad end down to its apex the two edges of the web turned over the angular sides of the form till they finally lapped together at its point where a pair of drawing rollers pinched them together and made a sharp fold line. This device was again patented by Mr. Archibald Sandeman of Edinburgh, Scotland, in 1870.[126] We made a working model of the device in 1877, and while it would fold a textile fabric, yet it was not possible to make it as then arranged, fold properly a web of paper of the thin, poor quality used by newspapers generally, the paper becoming so wrinkled and torn as to be entirely useless. Further experiments, however, showed that cut off sheets, either single or double ply, when conducted by tapes over a triangular form somewhat modified, were folded smoothly without retarding their speed. As a consequence of this result, it was thought that the requirements of newspapers in general would be better met by making all newspaper web machines as a rule, with the columns of the pages to run around the printing cylinders, so that their number could be increased or diminished at pleasure. Also to cut the web into four-page sheets and fold these over the triangle, singly, if desired, or collect and fold two of them together to form eight-page sheets. As the next fold would be a transverse one, it would be given by a folding cylinder, and a third fold could be given by a second triangle, thus one set of folding devices would fold the sheets without checking their motion. Two machines of this description were made in 1881 for the *Chicago Daily News* and proved so satisfactory that the style was adopted at once and many such machines have since been built.

Experiments and changes were still continued with the folding triangle with the object of enabling it to give a longitudinal fold to a web of paper of ordinary newspaper quality while running at a speed of 800 feet to 900 feet per minute, and they were finally so successful that it was adopted in a modified form in a machine ordered by the *St. Louis Globe-Democrat*, to

[126] British Patent No. 3,319, December 19, 1870.

print and fold 2, 4, 6, 8, 10, and 12-page sheets at a speed of 24,000 per hour. This machine printed a main web of double width or four pages wide, and a supplement web of two pages wide. The main web was slit lengthways centrally and one part brought under the other as shown in Crowell's patent of August 22nd, 1876. The supplement web was printed on a single type and impression cylinder, as shown in Crowell's patent of February 18th, 1879, and then entered between the two plies of the main web, and this three ply web passed down over a folding triangle of a rounded form and received a longitudinal fold. It continued on down to a pair of combined cutting and folding cylinders which cut it at page length into twelve page sheets and folded these transversely to half-page size and delivered them to a fly-cylinder which laid them on a slow moving apron. By successive reductions of the width of the supplement and main webs, sheets of ten, eight, six, four, and two-pages were produced. The machine was erected in the office of the *Globe-Democrat* in 1882 and operated so successfully that the proprietors soon ordered a duplicate machine.

Messrs. R. Hoe & Co. had built web printing machines of various styles and sizes, but the smallest one was made just at this time for Messrs. Goodwin & Co., of this city. It was for attachment to a cigarette making machine and printed a web of cigarette wrapping paper about one and a quarter inches wide, with a repetition of the words 'Old Judge' as it ran into the cigarette machine.

During those years ink makers had constantly improved their ink so the set-off from it in printing was now very much diminished and this permitted the second impression cylinders of web presses to be reduced from three and four times the diameter of the type cylinders to only twice their diameter without requiring a too frequent changing of tympans. The firm adopted this change with advantage, for it made the machine simpler, less expensive and more convenient.

In 1883 two three-page-wide web machines were built for

the Baltimore *Sun*, to print and fold that paper in six-page sheets and four-page sheets at a speed of 22,000 per hour, and two-page sheets at 66,000 per hour. For six-page sheets the web was three pages wide, and was slit in two lengthways at one-third of its width, and the row of pages thus cut off was transferred sideways and ran under one row of the two-page part. These associated webs passed over a folding triangle with sides formed of two cones which gave a longitudinal fold to the two-page web, and they were then cut into six-page sheets which were folded to half-page size by a pair of combined cutting and folding cylinders and delivered by a cylinder-fly, or they were folded to eight-page size and delivered by an 'S' fly. For four-page sheets the web was only two pages wide, and was cut and folded as for six-page sheets. For two-page sheets the web was three-page wide, and one-third cut off and turned under the two-thirds part, as for six-page sheets, but in running down the folding triangle the two-thirds part was slit in two lengthways, and the three narrow webs were cut into two-page sheets which were folded three together to half-page size, but easily drawn apart.

Experiments were still continued with the folding triangle with the result that as finally constructed it consists essentially of two round bars joined together at an angle so as to form the apex and two sides of a triangle, the space between the bars being covered by a steel plate. A pair of bending rollers are placed just above the point of the triangle, and the point itself has a projecting spring tongue, which, in folding, keeps the paper distended, and prevents its wrinkling on the fold line. L. C. Crowell's patent, December 1st, 1885.[127] A pair of combined cutting and folding cylinders is placed just below the folding triangle and receives from it the folded web which it cuts into sheets and folds them, and this is the form in which this folding machine is generally used.

[127] U.S. Patent No. 331,280, issued to Luther C. Crowell, Brooklyn, N.Y., and assigned to R. Hoe & Co.

A web machine was now brought out in simple and compact form, to print and fold two, four and eight-page sheets, and suitable for newspapers of moderate circulation. The web was two pages wide and was cut into sheets of page length before folding. These were guided over the folding triangle between tapes, and when folded singly, formed four-page sheets. For two-page sheets the single sheets were slit in two through their center margin and the resulting two-page sheets were folded up two together. For eight-page sheets, two four-page sheets were collected and folded together. The machine would work eight-page sheets at 10,000 per hour, and the other sizes in proportion, and the facility with which it could be changed to work one size or the other gave it the name of 'Presto' (Plate XXIII).

In 1884 the firm introduced a double-width web machine of very simple construction to print, fold and count in parcels eight-page and six-page sheets at a speed of 24,000 per hour, four-page sheets at 48,000 per hour, and two-page sheets at 96,000 per hour. The printed web is four pages wide and is slit lengthways centrally in two sections which are turned at right angles to the right and left respectively over oblique bars. For four-page sheets each section of the web runs to a folder, arranged one at each side of the machine, by which they are cut and folded. For two-page sheets each section of the web is slit centrally as it runs down its folding triangle, thus forming two-page sheets which are folded two together. For eight-page sheets one of the sections of the web is turned and runs under the other, and this two-ply web passes to one of the folders, and is cut and folded into eight-page sheets. For six-page sheets the web is only three pages wide, and the narrow web slit off runs under the wider one and forms six-page sheets. The folded sheets are laid on a moving apron by a cylinder-fly, and a break made in the sheets laid, marks them into parcels of any predetermined number.

An order was now received for a web machine for the Gov-

ernment Printing Office to print and fold the daily issue of the *Congressional Record*, which ordinarily consists of from eight to 32 octavo pages. The web is printed four pages wide, and by an arrangement of three combined cutting and folding cylinders it is cut transversely into sheets of 32 pages. These receive two transverse folds and are then crosscut into four sections of eight pages each which are laid on a moving apron. These sections are then stapled singly or several together, as the size of the day's issue requires. If the day's issue is sufficiently small it may be printed double or quadruple in the width of the web by duplicating the stereotype plates.[128]

The price of printing paper, owing chiefly to the use of wood pulp, was now being continually reduced, and machine typesetting lessened the cost of competition, and publishers of leading newspapers, taking advantage of these conditions, were issuing supplement sheets of two and four pages to their ordinary editions. These supplements were inserted loosely in the regular sheets by hand, which was both expensive and unsatisfactory, so a supplement web machine was built in 1885 for the *New York Herald*, to print, fold and count twelve, ten, eight, six and four-page sheets, at a speed of 24,000 sheets per hour, and two-page sheets at 144,000 per hour (Plate XXIV). This machine consists of a four-page wide main press and two-page wide supplement press, as in the two machines previously made for the *St. Louis Globe-Democrat*, but the whole machine is of a simpler and more compact construction. For folding twelve-page sheets the main web is slit lengthways centrally into two equal sections, which are turned at

[128] In his annual report for 1885, the Public Printer referred to this press: 'Since the adjournment of the last Congress I have purchased one of the latest improved fast web presses, calculated especially for printing the Record; also with a view of printing document work (during the recesses), the press facilities for doing which have been and are now inadequate. The new press will print and fold the whole daily edition of the Record within one hour.' The cost of this press appears in the disbursements: '1 stereotyping perfecting-press, 1 wetting-machine, 1 curved casting-mold, 1 curved beveling-machine and saw table, 1 finishing-block, 1 shaving-machine, 1 crane . . . . . 25,000 00.' (*Annual Report of the Public Printer*, Senate Misc. Doc. 62, 49th Cong., 1st Sess., pp. 4, 33.)

right angles by two oblique bars so placed as to bring one section over the other. The two-page web from the supplement press, which is placed at one side of the machine, passes directly under these sections, and these three webs, pasted on their center line, run to a folder at the opposite side of the machine which cuts them into sheets and folds them. By reducing successively the width of the supplement and main webs, ten, eight, six and four-page sheets are produced. For two-page sheets, the three webs without paste, are slit in two lengthways on the folding triangle, and cut and folded six two-page sheets together. All the sheets are laid on an apron by a revolving fan-fly, and a break in the line of sheets counts them in parcels. This machine was the first to which a web controlling device was applied. This device consists in driving the web or roll of paper positively by means of a broad rubber belt and pulley which rests on its surface, and a governor is arranged to throw the belt into operation when the press runs slowly and to release it when the press runs at nearly its speed. The effect of this is to start the roll independently when the press starts, hence no danger of breaking the paper, and when the press stops the roll is stopped positively and not allowed to over-run and unwind. L. C. Crowell's patent, June 21st, 1887.[129]

STEPHEN D. TUCKER

[129] U.S. Patent No. 365,051, issued to Luther C. Crowell, Brooklyn, N.Y.