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The X-Patents

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ABSTRACT

The first American patents issued by the United States Patent and Trademark Office (USPTO) were designed as X-Patents. About ten thousand were issued, from July 1790 to July 1836, by almost 7000 inventors, following the Patent Acts of 1790 and 1793. Patents had come of age. Unfortunately, most documents (around 75%), that were just named and dated, were burned in a fire, which occurred on December 15, 1836. Such documents received this specific identification (X-Patent) because they were retrospectively renumbered. We applied new procedures such as data mining to arrive at new correlations and results. For example, it was possible to find first, middle and last names of inventors, assignees, witnesses and manufacturers in most patents. The objective is to describe the earliest United States patents and present some landmarks that cover almost half a century and constitute the dawn of innovation and the rise of the Industrial Revolution in America.

1. Introduction

According to the UK *Intellectual Patent Office* (www.IPO.gov.uk), the United Kingdom has one of the longest uninterrupted patent traditions in the world. Its history dates from the 15th century, when the Crown began to issue definite grants to inventors, traders and manufacturers – they were determined as *litterae patentes* [1]. Since this time, patents, in the context of an open letter, have been considered as a form of intellectual property, with a twenty years' privilege.

More precisely, the first English recorded patent was granted to the Flemish glassmaker John Utynam by King Henry VI of England (1421–1471) in April 3, 1449. One hundred years after Utynam's first patent letter in 1449, no additional patents were granted [1,2]. The second technical patent, also for glassmaking and with a twenty-year monopoly, was granted by King Edward VI of England (1537–1553) to the London merchant Henry Smyth on April 26, 1552 [1,2]. Both are related to the production of colored window glasses. Only three and half centuries later the first patents were granted in America.

Granting patents were allowed as royal prerogatives in absolutist England [1]. In America, the first patents were issued only fourteen years after its independence, in 1790 (to Samuel Hopkins, as described below), as part of a plan for the industrial revolution. A simple examination was the only requirement to obtain the first patents. This was changed with the passing of the Patent Act of 1793. The inventor was required to submit "a specification … containing a description … not only distinguish[ing] the invention … but also to enable" someone familiar with the art to use the invention for its intended purpose [3]. This requirement was made in a written text and sometimes included a drawing and/or model. Applicants were not asked to give an oath [4].

The first American patents are also described as "name and date patents" because they were not numbered when issued [5]. After restoration, such patents were retrospectively signed and numbered starting with 1X, 2X … and today they are known as the "X-Patents." The last X-Patent was issued to Samuel Wolston, under number 9,902X, about a "Fractured thigh apparatus", on July 2, 1836.

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However, Risch [5] affirmed that the content of the early American patents is still ignored. For example, at that time, patent specifications were not required to incorporate claims until the Patent Act of 1870, eighty years after the first patent publication.

Many X-Patent records are incomplete, frequently missing either drawings or specifications. More specifically, since the early practice, the patent letters issued to the inventor did not always restate the full specification. Only approximately 25% of the X-Patents were restored or partially recovered [5]. The Act of March 3, 1837 provided the restoration of lost patent documents and models. However, the Directory of American Tool and Machinery Patents [6] verified at least 256 X-Patents that were not numbered, and 90 others that were considered fractional, due to retrospective renumbering.

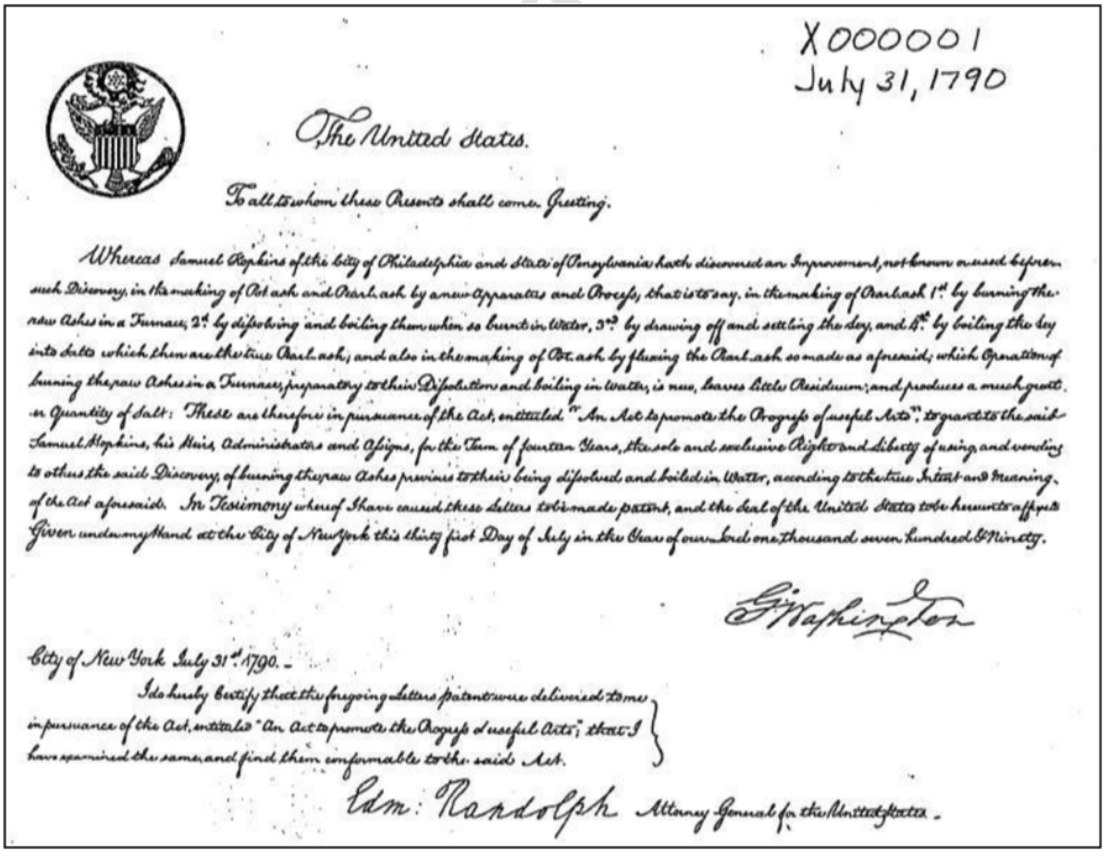
For instance, in 1841 the American inventor John Brown Emerson of New York filled in documents to restore his March 8, 1834, 8,053X patent – named "Screw propeller" – more precisely, for "certain improvements in the steam engine, and in the mode of propelling therewith either vessels on the water or carriages on the land". He submitted a new corrected drawing of a propeller in March of 1844 [5]. More details of his innovation were published at the *J. Franklin Institute* [7], or in the documents of the action (or the patent judicial decision) 47 *U.S.* (6 How.) 437 in 1848, between Emerson and the American inventors Peter Hogg (*unknown - c.* 1868) and his cousin Cornelius Henry DeLamater (1821–1889).

Additional information on X-Patents can be found in the *Register of Name and Date Patents* 1790–1836 [8] and provides lists of patents such as those done by Commissioners Edmund Burke (1809–1882) [9] and Mortimer Dormer Leggett (1821–1896) [10], as well as *The Patentee's Manual* of William Elliott [11] and the above cited *J. Franklin Institute*.

Beginning in July 1836, with *US* Patent No. 1, new inventions were numbered when granted, starting the contemporary process, reaching nine million issued patents in 2015 by the United States Patent and Trademark Office: www.USPTO.gov. It is important to note that this procedure was interrupted during the Civil War (1861–1865), when at least 266 patents were numbered according to the Confederate States of America Patents, from July 23, 1861 to November 23, 1864 [6]. More precisely, there were 57 patents published in 1861, 75 in 1862, 89 in 1863 and 45 in 1864, involving 238 inventors. It is important to note that the highest number of such confederate patents, issued during the Civil War, were almost the same amount as the X-Patents produced sixty years before.

2. The first X-Patents

The 1X American patent was issued to the American inventor Samuel Hopkins (1743–1818) from Philadelphia, on July 31, 1790, for an improvement "in the making of Potash and Pearl ash by a new Apparatus and Process" [12], Fig. 1. *Potash* is potassium carbonate (K_2CO_3) in an impure form mixed with other potassium salts; and *pearl ash* is a superior product. Hopkins produced such materials by burning wood ashes for a second time before dissolving them to extract potash [13]. It is interesting to observe that the first invention was in Chemistry. This patent was backed by the President George Washington (1732–1799) and by the Secretary of State Thomas Jefferson (1743–1826). Potash and pearl ash were crucial for the making of soap and glass as well as saltpeter for gunpowder, baking, fertilizer and dye-


X000001
July 31, 1790

The United States.

To all to whom these Presents shall come. Greeting.

Whereas Samuel Hopkins of the City of Philadelphia and State of Pensylvania hath discovered an Improvement, not known or used before such Discovery, in the making of Pot ash and Pearl ash by a new Apparatus and Process, that is to say, in the making of Pearl ash 1st by burning the raw Ashes in a Furnace, 2d by dissolving and boiling them when so burnt in Water, 3rd by drawing off and settling the ley, and 4th by boiling the ley into Salts which then are the true Pearl ash; and also in the making of Pot ash by fluxing the Pearl ash so made as aforesaid; which Operations of burning the raw Ashes in a Furnace, preparatory to their Dissolution and boiling in Water, is new, leaves little Residuum; and produces a much greater Quantity of Salt: These are therefore in pursuance of the Act, entituled "An Act to promote the Progress of useful Arts", to grant to the said Samuel Hopkins, his Heirs, Administrators and Assigns, for the Term of fourteen Years, the sole and exclusive Right and Liberty of using, and vending to others the said Discovery, of burning the raw Ashes previous to their being dissolved and boiled in Water, according to the true Intent and Meaning of the Act aforesaid. In Testimony whereof I have caused these Letters to be made Patent, and the Seal of the United States to be hereunto affixed. Given under my Hand at the City of New York this thirty first Day of July in the Year of our Lord one thousand seven hundred & Ninety.

G. Washington

City of New York July 31st 1790.

I do hereby certify that the foregoing Letters Patent were delivered to me in pursuance of the Act, entituled "An Act to promote the Progress of useful Arts", that I have examined the same, and find them conformable to the said Act.

Edm: Randolph Attorney General for the United States.

Fig. 1. The first *US* patent, issued to the American inventor Samuel Hopkins (1743–1818), of Pittsford, Vermont, on July 31, 1790, for an innovative way of making "pot ash and pearl ash". *Courtesy*: The *United States Patent and Trademark Office* (document in public domain: https://www.uspto.gov/patents-application-process/search-patents).

ing fabrics [14]. There are no patent drawings available for this case, but Hopkins had patents issued for two other inventions: 1,985X (Aug. 19, 1813) and 2,797X (May 31, 1817), both about a preparation method of mustard flour. This first American patent is linked to one of the first chemical industries in America.

The first evidence of glassmaking in the United States was in an English settlement on Jamestown Island, Virginia around 1608 [15]. The location came to be called *Glass House Point*, but the production was discontinued. Just a century later, another glasshouse was created in North America by the German glassmaker Caspar Wistar (1696–1752) who moved in 1717 to Pennsylvania, starting with soap making and brass button production. Ten years later he set up what is considered the first successful glass factory, the *Wistarburgh Glass Works*, also known as the *United Glass Company* [16]. Checking X-Patents with glass in the title, there are 51 documents registered by USPTO. Unfortunately, there is no direct correlation between the Wistar Company and any of these granted patents. The first one was granted on February 14, 1799 by Benjamin Duval (235X, about a glass cutter)".

The 2X patent was issued to the American inventor Joseph Stacey Sampson (*unknown* - 1798) from Boston, Massachusetts. His invention helped the "Manufacturing of candles." Later on, the Boston candle maker helped to invent the continuous wick [17]. Sampson had patents granted for two other inventions: 64X (July 05, 1793), related to applying and regulating the sails of ships and boats; and a last patent: 176X (June 26, 1797), also on manufacturing candles,but no more information is available in the database.

The 3X patent was issued to the American inventor, engineer and businessman Oliver Evans (1755–1819) from Philadelphia, Fig. 2. Evans was considered an inventive genius of first magnitude [13,18]. His innovations used control mechanisms and conveyors so that no labor was needed from the time grain was loaded into the elevator buckets until flour was discharged into a wagon, inventing an elaborate automated flour mill. Evans wrote that the mill worked "without the aid of manual labor, excepting to set the different machines in motion." He had seven further X-patents granted: 117X, 267X, 518X, 519X, 817X, 1,490X and 4,087X about millers, stoves, a steam engine (the first in America), sawmills and plows [18]. His most famous invention, though, may be the *Oruktor Amphibolos*, or Amphibious *Digger* - that made the first self-powered amphibious vehicle possible, Fig. 2. In 1814 he wrote a prophecy: "the time will come when people will travel in stages moved by steam engines, from one city to another, almost as fast as birds fly, fifteen or twenty miles in an hour" [13].

The 4X patent was issued to Francis Bailey (1744–1817), Fig. 3. He was a Philadelphia-based printer with influent friends, so it's no surprise he landed a "punches for type" patent on January 29, 1791. Bailey also printed the first official copy of the American Articles of Confederation and Perpetual Union. Further details can be found at the Library of Congress, specifically at the Primary Documents in American History section.

The 5X patent was granted to Aaron Putnam (1733–1813) of Medford, Middlesex County, Massachusetts, on January 29, 1791, for improving the distilling process. Sadly, there's no record of what he was distilling. He granted the patent just two months before the Whiskey Excise Act became law creating the tax that sparked the Whiskey Rebellion in 1791.

The 6X patent was issued to John Stone (1728–1791) of Concord, Middlesex County, Massachusetts. He possibly saved workers from hundreds of man-hours of labor after he invented a pile driver for bridges, which was granted a patent on March 10, 1791.

The 7X to 10X patents were issued to the inventor Samuel Mullikin (*c.* 1750 - *unknown*) of Philadelphia. He became the first inventor to hold multiple patents, all of them granted on the same day: March 11, 1791. His first invention was a "Machine for threshing grain and corn". His second invention helped to break hemp, while his other two contraptions helped to cut and polish marble and raise a nap on cloths. He has two other patents granted: 91X (January 15, 1795, about flax and hemp machines) and 152X (February 20, 1797, about a miller).

All these first ten patents came from two different places in America: Philadelphia city (the seat of the federal government at that time) or the State of Massachusetts, both populous regions in that period, in a country of less than four million people [13]. It is also important to note that the first three members of the American Patent Commission (or *Patent Board*) were the Secretary of State Thomas Jefferson (1743–1826), the Secretary of War Henry Knox (1750–1806), and Attorney General Edmund Jennings Randolph (1753–1813). According to Dobyns [13], they determined in each case whether a patent should be

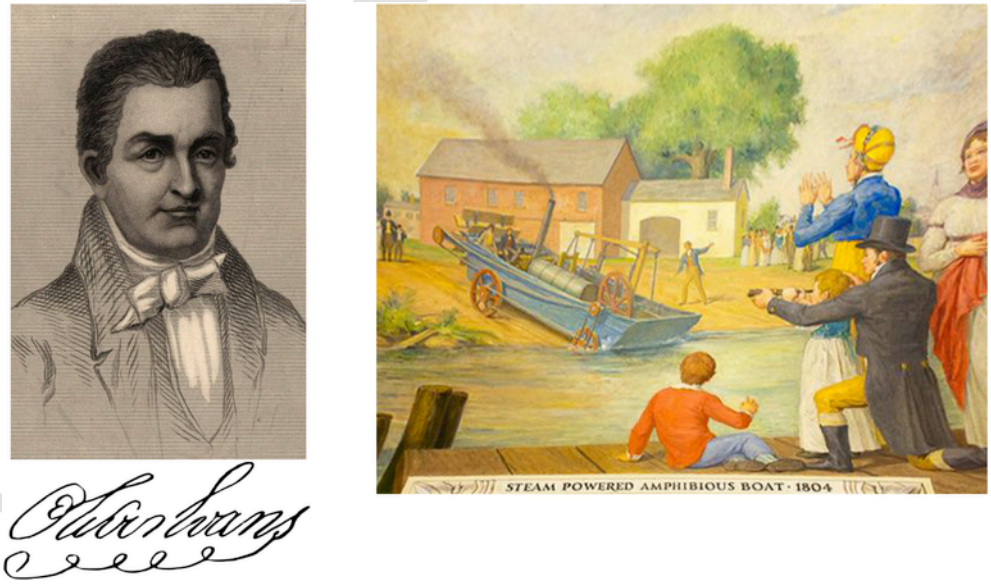
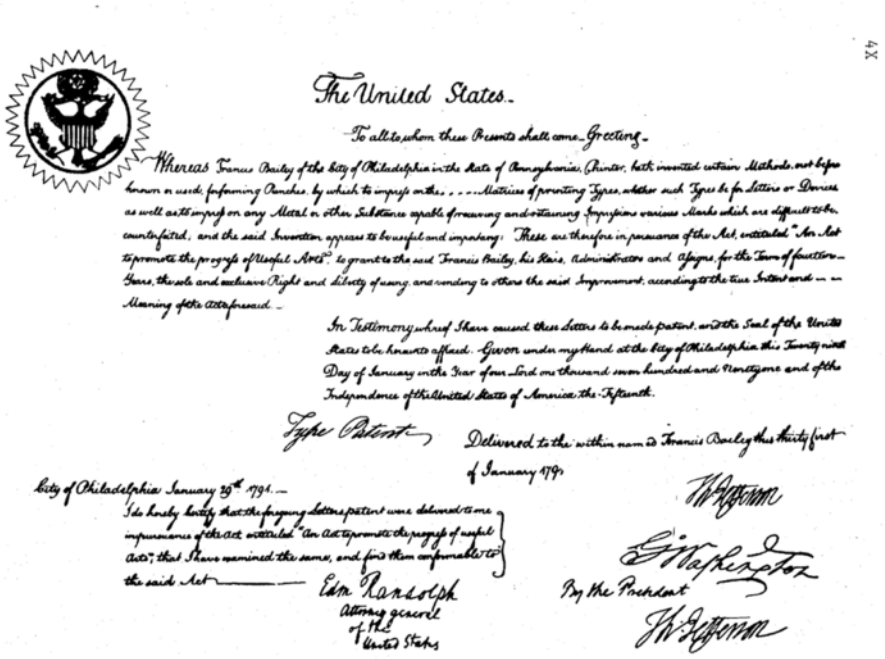


Fig. 2. Oliver Evans (1755–1819), American inventor, engineer and businessman, the third person to have issued an X-Patent, and his well-know engine *Oruktor Amphibolos*, a steam powered amphibious boat, around 1804. Engraving by William G. Jackman around 1841. Figures in public domain, as for example in Wikipedia.


The United States.

To all to whom these Presents shall come Greeting.

Whereas Francis Bailey of the City of Philadelphia in the State of Pennsylvania, Printer, hath invented certain Methods not before known or used, for forming Punches by which to impress on the Matrices of preparing Types, whether such Types be for Letters or Devices as well as for impressing on any Metal or other Substances capable of receiving and retaining Impressions various Marks which are difficult to be counterfeited, and the said Invention appears to be useful and important. These are therefore in pursuance of the Act, intituled "An Act to promote the progress of useful Arts" to grant to the said Francis Bailey, his Heirs, Administrators and Assigns for the Term of fourteen Years, the sole and exclusive Right and Liberty of using and vending to others the said Improvement, according to the true Intent and Meaning of the Act aforesaid.

In Testimony whereof I have caused these Letters to be made Patent, and the Seal of the United States to be hereunto affixed. Given under my Hand at the City of Philadelphia this Twenty ninth Day of January in the Year of our Lord one thousand seven hundred and Ninety one and of the Independence of the United States of America the Fifteenth.

Delivered to the within named Francis Bailey this thirty first of January 1791

City of Philadelphia January 29th 1791.

I do hereby certify that the foregoing Letters Patent were delivered to me in pursuance of the Act intituled "An Act to promote the progress of useful Arts" that I have examined the same, and find them conformable to the said Act

Edm. Randolph Attorney General of the United States

By the President

Fig. 3. The fourth *US* patent, issued to the American inventor Francis Bailey (1744–1817), of Philadelphia, on January 29, 1791, for an innovative way of producing "Punch for making printing type". *Courtesy*: The *United States Patent and Trademark Office* (document in public domain: https://www.uspto.gov/patents-application-process/search-patents).

granted. This system was modified in the following years, due to the increasing rate of patent application submissions.

Following ancient English tradition, when only the King was allowed to sign *letters patent* [1,2], the first American presidents also signed the first American innovations, applying the Great Seal, as show by original documents, as presented for example in Figs. 1 and 3. This particular system started to break down very early, due to the fast increase in the number of issued patents, as verified in Fig. 4. This figure presents the number of patents distribution results for American patents from 1790 to 1836. From this result, it is possible to note that there were at least three years with a great number of patents granted: 1812, 1830 and 1835 (800 patents at this particular year). It is important to note that even during the 1812 US War, the innovations did not decrease. There was also an average number of 215.2 and a median of 172.0 issued patents per year during this period. Just for comparison, according to Spear [19], around the 1840s the average number of UK patents granted was about 450/year and, after 1852, when procedures were simplified and became cheaper, the rate increased to over 2000/ year. Such numbers are quite similar to those in America at the same period, but it is important to observe that the UK has the longest tradition on patents, since 1449 [1,2].

Fig. 5 presents the ten most prolific inventors from 1790 to 1836. Some of the top ten inventors of the period of X-Patents were Isaiah Jennings (1782–1862) of New York, with 28 invention records [20] in several areas such as agricultural machines, armaments, household machines, propulsion and energy, among others, followed by Eliphalet Nott (1773–1866) of Schenectady, with 26, and John James Giraud (1754–1839) and John Goulding (1781–1859), both with 22 patents [6].

It is worth mentioning that the American inventor, mechanical engineer and physicist Jacob Perkins (1766–1849) published twenty American and nineteen English patents on many subjects, as nail machines, hydrostatics, engraving, steam power and refrigeration. This last innovation (GB 6662: "Apparatus and Means for Producing Ice, and in Cooling Fluids", on August 14, 1835) is considered to be the first patent for the vapor-compression refrigeration cycle. Perkins based

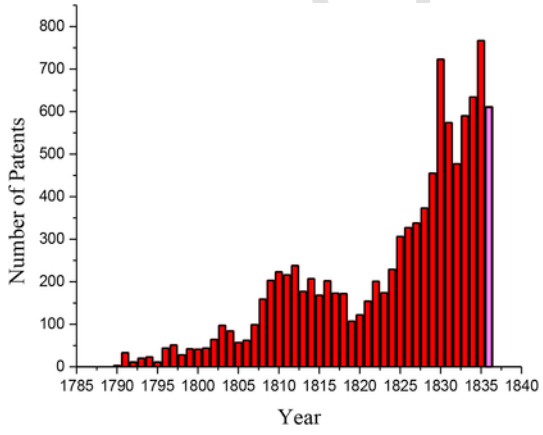


Fig. 4. Frequency distribution results for American patents from 1790 to 1836, considering also FX and NX-Patents. Data from www.DATAMP.org.

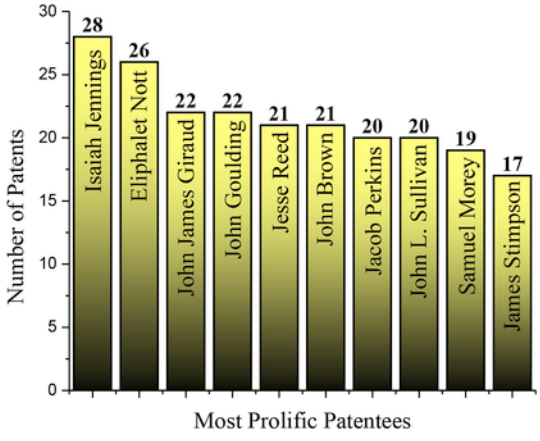


Fig. 5. Top ten most prolific patentees from 1790 to 1836, considering 6963 inventors. Data from www.DATAMP.org.

his patent on the ideas of Oliver Evans, but never built a refrigerator. Another prolific patentee in Britain was the English inventor Joseph Brahmah (1748–1814) with eighteen innovations [21].

Fig. 6a shows the top ten categories of the X-Patents issued between 1790 and 1836. From this figure, most innovations were not indicated (around 37.0%), followed by miller (4.1%), stove (2.6%) and spinner (2.4%) patents. According to Risch [5], old patent classification is notoriously vague. However, the USPTO granted patents under some general categories, and the top three old classifications were: Stoves and Furnaces (Class No. 126); Crop Threshing or Separating (Class No. 460); and Solid Material Disintegration (Class No. 241). Risch [5] also noted that this historical classification represents only 6.5% of the patents.

Fig. 6b shows the top ten new X-Patents organized by class according to a classification procedure [6] as described below. From this figure, most innovations were not indicated (around 36.0%), followed by specific trade (around 16%), agricultural machines (around 11%), specialty machines and propulsion and energy (both around 6%). The low number of each of indicated categories would represent innovative diversity, and are consistent with categories found in other studies of early patenting [5]. The great absence of indications presents a failure

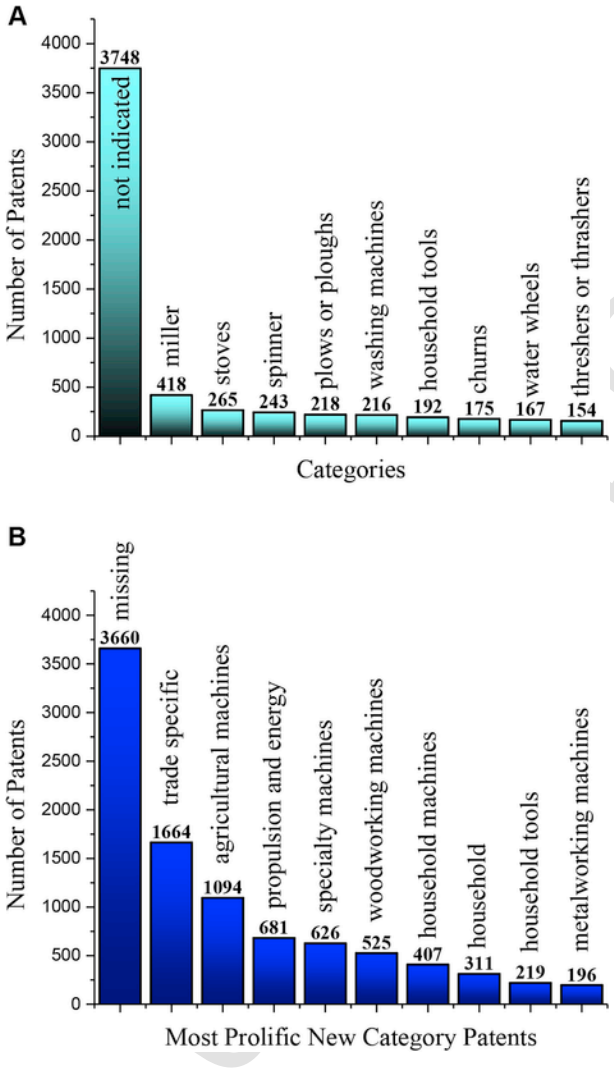


Fig. 6. a) Top ten categories of the X-Patents issued between 1790 and 1836. From this figure, most innovations were not indicated (around 37.0%), followed by miller (4.1%) and stove (2.6%) patents. Data from www.DATAMP.org. b) Some new classification suggestions for the most prolific new category patents, including 3660 missing cases using data mining, as described on text.

on the American X-Patent system. In fact, Risch [5] also affirmed that if one applied for a X-Patent, this person almost had a patent granted at that time. This statement is proved by analyzing the time elapsed between the registration and the granting of the patent 9,474X (applied November 11, 1835; granted March 4, 1836), in less than 1 year. According to Risch [5], poor patent quality was one of the reasons for the reinstitution of the examination system after the Patent Act of 1836, and the inclusion of patent claims section. Certainly there were also naive proposals as well as innovative advancements due to the rise of scientific knowledge at that time, and the reader can find some examples elsewhere [5,6,13].

Despite such criticisms, the resulting patent categories, presented in many references [9,10] are linked to important technological developments, as machine tools, lighting, agriculture and textile manufacture. It is also possible to cite others, as metallurgy, chemicals, steam power, mining, glass making and transportation, all of them with huge economic, political and social impacts in daily life.

Fig. 7 presents the top ten most prolific years of American patents from 1790 to 1836. Note that at 1830's decade there was an increase in the number of patents issued. Also, it is important to consider that it was computed granted patents until July 2, 1836 due to the great fire.

All X-Patents received the letter X associated with the patent number in the USPTO database and as it appears on the document. This X is generally added to the end of the patent number, except for the first patent which has the X in the beginning of the number, according to Fig. 1.

However, not all X-Patents were fully identified. Since the very beginning, it was necessary to make a retrospective renumbering, creating some “fractional patents” where the patent identification ends in a fraction. DATAMP [6] presents 90 fractional X-Patents, from 1812 to 1836, with a low frequency of such patents per year (around two) – only in the last three years before the fire the number of fractional patents reached its maximum - 23 issued patents (in 1835).

In the USPTO database [6] a capital letter represents the fraction. This procedure was taken to preserve the correct sequence. This letter is derived from a system of 1/16ths where *A* is 1/16; *B* is 2/16 (or 1/8) up to *O*, 15/16. Most fractional X-Patents end in *H* or ½, but one can find others ending in *D* (¼), *L* (¾), or *N* (⅞), such as those presented in Table 1, issued immediately as 8,736X, due to approximately the same date of issuing.

There were also 256 non-identified patents, classified as *NX*, that were named and dated from 1816 to 1836, with a low frequency of granted patents per year. But there were two years: 1824 and 1830, when the frequency reached its maximum, of 22 and 173 grants, re-

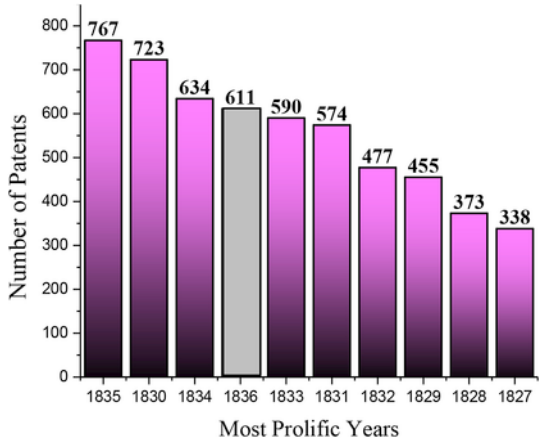


Fig. 7. Top ten most prolific years of American patents from 1790 to 1836. See that the 1830's decade showed an increasing on the number of patents issued. It is important to note that in 1836 patents were only considered until July. Data from www.DATAMP.org.

Table 1
Examples of fractional X-Patents from different authors, that were renumbered as indicated. There was a total of 23 fractional patents issued in 1835.

Patent number			Patentee	Title	Date
8,736X			Daniel Harrington	Galvanic Apparatus	March 31, 1835
8,732FX	8736 ¼X	8,732D	John Deakyne	Straw Cutter	April 2, 1835
8,734FX	8736 ½X	8,736H	Orlando Mack	Bee Hive	April 2, 1835
8,735FX	8736 ¾X	8,736L	Luther Carman	Horse Power	April 2, 1835
8,736FX	8736 ⅞X	8,736N	Aaron Hale	Wheel	April 2, 1835

spectively. This can also be interpreted as a signal of the failure of this old patent system, that collapsed before the great fire. Clearly, it verified the inability of the Patent Office to refuse applications without merit, especially about frauds, and a committee presented a new patent act in 1836 [13].

Such new proposals were necessary because important modifications occurred since the US Act of 1793, that ranges from the extreme of rigid examination to the opposite extreme of no examination at all [13]. The US Patent Board was abolished, and innovation requirements were restricted to citizens [13] (*i.e.*, not to slaves). Another important reason was that, by 1835 it took at least three months to get all of the necessary signatures by the Secretary of State, the Attorney General, and the President of the United States to issue a patent. As a point of interest, it is important to cite Dobyns [13], who affirmed that in the early days there was a single pony that "was kept by the Government for the use of the Patent Office … and that the messenger … to have the patents signed by the Secretary of State … [or] the Attorney General and the President of the United States".

3. Data mining

Data mining is a powerful computing process that allows to extract information and analyze patterns from a large data set [22] and using web crawlers for data mining in patent databases is common [23]. For this work, we harvest clean and normalized data. After this we applied the following *softwares*: *Nvivo* [24] and *Mysql* [25] for parsing procedure. Doing this we applied both softwares as the main parts of a computing process for data mining - this method is usually indicated to conduct the analysis of large data volumes [23]. Only recently some papers were published about methods to analyze patents [26,27]; and others, on how to develop such analysis [28,29].

We have analyzed two databases, an original one and one which was modified by us. These two databases contain the same number of patents ($N = 10114$). The first database is the original DATAMP [6], that presents as variables only a set of six items of abbreviated data, as patent number, a *link* to internet database, publication date, patentee, title and type. Some information as the patentee information itself created some difficulties at first. For example, due to mismatches on author identification, as the presence of homonyms, mainly due to abbreviated names. Data mining provided ways to find first, middle and last names of inventors, as well as assignees, witnesses and manufacturers in most patents. We present a brief example of such information at Table 2. We also observed 3748 cases with no information in the column (*Type*) considering all 10114 patents. The column (*Type*) listed in original DATAMP corresponds in fact to a (*Category*) classification. To proceed with a better understanding we renamed the *Type* column to *Category*, for a better comprehension of the information from original DATAMP database.

Briefly, we analyzed how the classification of the 10114 patents in the "Class" column was distributed in DATAMP. From these, 4695 were linked (and then classified as the first step) to a single *Class*; 1604 were linked to two different *Classes*; 64 to three different *Classes*; 3 to four different *Classes*; and 88 did not present *Class* identification, only *type*. In fact, these last patents presented a category registry which allowed by means of comparison to retrieve and suggest another *Class* record. Finally, 3660 did not have *Class* or category identification, but they had additional information in the subtitle or the subtitle resume, which allowed new information(s) through a comparison of existing terms. It was in this way that was possible to identify specific *classes* for such patents.

More specifically about this last point (category), according to the www.DATAMP.org database, the classification named *Class* was the broadest "*Category*", because it represents various class sub-types. In this work, *Type* represents various sub-types of a category, while *Subtype* represents the lowest classification level and the classifications can be changed over time. We also emphasize that the same patent can be linked to more than one *Class* and *Category*. For example Patent number 5X has Class = "specialty machines" and Category = "distilling apparatus" or Class = "propulsion and energy" and Category = "steam apparatus" and Type = "steam stills". For these cases we maintained as a reference the class, category, type and subtype indicated in original DATAMP base to establish the descriptions and analysis carried out in this study.

After analyzing original DATAMP data, we identified the need to verify if there was more information in the www.DATAMP.org database, which could complement the missing data of the columns (*Type/Category*), or at least reduce the possibility of homonymous cases of the column (*Patentee*), for example by locating the full name, and not abbreviations as we find in original data everything concerning patentees.

This need led the authors to proceed to a new data mining approach on original DATAMP, through a more precise procedure, devel-

Table 2
Brief information obtained about the first three X-Patents from original DATAMP source [6]. The data contains only six variables: patent number, link to internet database, publication date, patentee, title and type.

Number	1X	2X	3X
Link	http://www.datamp.org/patents/displayPatent.php?number=1&typeCode=3	http://www.datamp.org/patents/displayPatent.php?number=2&typeCode=3	http://www.datamp.org/patents/displayPatent.php?number=3&typeCode=3
Date	Jul. 31, 1790	Aug. 06, 1790	Dec. 18, 1790
Patentee	S. Hopkins	J. S. Sampson	O. Evans
Title	Manufacture of Pot Ash and Pearl Ash	Manufacturing Candles	Manufacturing Flour and Meal
type	NULL	Chandler	miller

oped by the present authors. From the initial six items (patent number, a *link* to internet database, publication date, patentee, title and type) it was possible to obtain more information – more precisely: patent number, link to internet database, full patentee name, resume, type, subtitle, categories, patentee city, patentee state, classification, assignee(s) name(s), assignee(s) city(ies), assignee(s) state(s), manufacturer name, manufacturer city, manufactures state, witnesses names, date applied, the document in .pdf format, publication number, publication type, external links (as the USPTO), descriptions, references citing such patent, references about filling date, references on publications, references on applicants, reference titles, a new cooperative classification, inventors and the original assignee. With this new information it was possible to assess correlations more precisely.

Thus, in summary, additional classifications were defined using the same terms to designate *Class*, *Category*, *Type* and *Subtype* already described from original DATAMP database. Based on normalization and classification described above, the present authors adopted such criteria, based on comparison of terms that were obtained to suggest the closest possible classification from data mining for all cases other than the first classification step.

For this task we present a summarized protocol: *a*) opening the electronic address provided in the column (*link*); *b*) identification, categorization, selection and storage of information available in the main *link* (http://www.datamp.org/patents/advance.php?pn={variable1}&id={variable2}&set={variable3}) and *sub-links* (https://www.google.com/patents/{variable 4}); and *c*) storing data in a new database, called DATAMP_Plus. A new column (*Tool_Categories*) created from DATAMP_Plus would list the *class*, *category*, *type* and *subtype* to which a particular patent is related. For a suggestive new classification, about the 3660 missing cases, we subdivided the column (*Tool_Categories*) into *(Class*_Plus) and (*Category*_Plus) respectively. This action allowed us to recover the "*Class*" classification from 6454 cases of all $N = 10114$ patents analyzed.

Thus, the second database, organized by us, is briefly shown in Fig. 8. This new database, DATAMP_Plus, presents a set of full name data in the (*Patentee*_name) column, which made it easy, for example, to correctly identify the author given the possibility of correlating with other columns as (*Patentee*_city) – for example, about the city of each patentee; and the new column (*Patentee*_uf) allow us to identify the state of each patentee. In resume, these data allowed the authors to deal better with possible homonyms. We also identified a reduction of the missing cases, of 3748 to 3660 of all 10114 patents, just after analyzing the column (*Tool Categories*). One example of DATAMP_Plus applied to the first three X-patents in shown in Table 3.

To classify these 3660 missing patents, we considered the use of the "*Class*" term because it presented a lot of information and was available in the column (*Tool_Categories*), as previously presented. A summary protocol to fill this specific column (*Class*_Plus) followed two basic steps:

i) In the first step, we run the following *Mysql* command as briefly indicated in Table 3, update uspt_new set class_plus = substring_index(categories,'; ',1) where categories not regexp '[[:<:]]null[[:>:]]'; This command allows one to extract "*Class*" from patents that have their information in the (*Tool_Categories*) column (6454 cases returned of all 10,114 patents).
ii) For the next step, extracting "*Class*" from the 3660 missing cases related to (*Tool* Categories) column we treated data considering a combination of Mysql and Nvivo results as the following:

1. Identify the existing list of 40 "*Class*[*es*]" from www.DATAMP.org. Examples: agricultural machines; agricultural tools; armaments; etc;
2. Select for each "*Class*" the set of terms available in "*Category*", "*Type*" and "*Subtype*" from www.DATAMP.org.
3. From DATAMP_Plus database analyzed we exported the columns (*Subtitle*_resume/*Title*), (*Subtile*), (*Class*_Plus) and (*Category*_Plus) for Nvivo.
4. From Nvivo, we created the nodes used to sort the 3660 missing cases. This term can represent a code, theme, or idea about the data one wants to analyze. The node is a statement that allows anyone to create hierarchies and relationships as general topics (such as a parent node) to a more specific (as a child node). The nodes were created using the classifications [30] "*Class*" and sub-classifications "*Category*".

To sort all cases we initially ran the procedure *Automated Insights*[1] [31] for a general comprehension of classification suggestions made by Nvivo *software*; this sequence refined the classification performing a clear analysis for the suggested cases. This action allowed us to perform some classification changes suggested by the Nvivo for specific cases. With the use of such data mining, creating thus a DATAMP_Plus database, it was possible to access more valuable and interesting information. Thus, Fig. 6b presents the top ten most prolific categories of the X-Patents; data mining improved approximately 0.02% when compared to original DATAMP: column (*Type*) databases with DATAMP_Plus, column (*Class*_Plus) from 3748 to 3660 missing cases.

Fig. 7 presents the top ten most prolific years of the X-Patents, that is related to the first figure. From Fig. 1 it is possible to note that in the 1790–1810 period there was a fast increasing on patent grants; between 1810 and 1819 there was a decrease in such registrations, maybe due to the War of 1812; from 1820 to 1830 a substantial increase was registered in the period of ten years, considering the history reported; between 1830 and 1832 there was a rapid decline of approximately 300 records followed by a rapid increasing between 1832 and 1835, followed by a decline from 767 to 611 records in 1836.

Fig. 6b presents the classification suggestion for the most prolific new category of patents, including 3660 missing cases using data mining. By means of a new procedure including a specific Nvivo routine (not show in this graph), it was possible to identify such 3660 patents, leaving only 49 missing cases as new not identified ones. For this particular task the most used words of each patent were associated with the original DATAMP.org classification, as titles and subtitles, making it possible to cover almost 98% of identified classes.

Fig. 9 presents the top ten most prolific patentees' cities; about ten percent of patent registrations occurred from New York habitants; other seven percent from Philadelphia, and another seven percent are associated with missing patentee's locations.

Table 4 shows some available information of new classifications related to specific X-Patents and respective assignees. Our results showed that of about 25% of information available on the licensing of X-Patents, 36% were licensed for agricultural machinery and another 16% for specific trade. The assignee Ashton Johnson was granted two patents: 7,811X and 7,812X, both related to tobacco manufacturing linked to the new class named agricultural machinery.

[1] Briefly, the process and comparison analysis occurred as follows. Each case group that not followed the first classification step was analyzed using Nvivo. By means of the *Automated Insights algorithm*, Nvivo suggested to group patents according to simple term comparisons. One researcher first analyzed such grouping suggestions and any disagreement with Nvivo suggestion the patent was marked for further analysis. A second researcher performed the same procedure as the previous, and if there were any agreement with suggestions done, then a class was maintained. And if there were disagreement, a third researcher would analyze and tried to decide about other class options. This procedure reduced the interference of individual class classifications, but as any human process, it is liable to some error. But as DATAMP itself points out, the database is constantly reviewing its ratings.

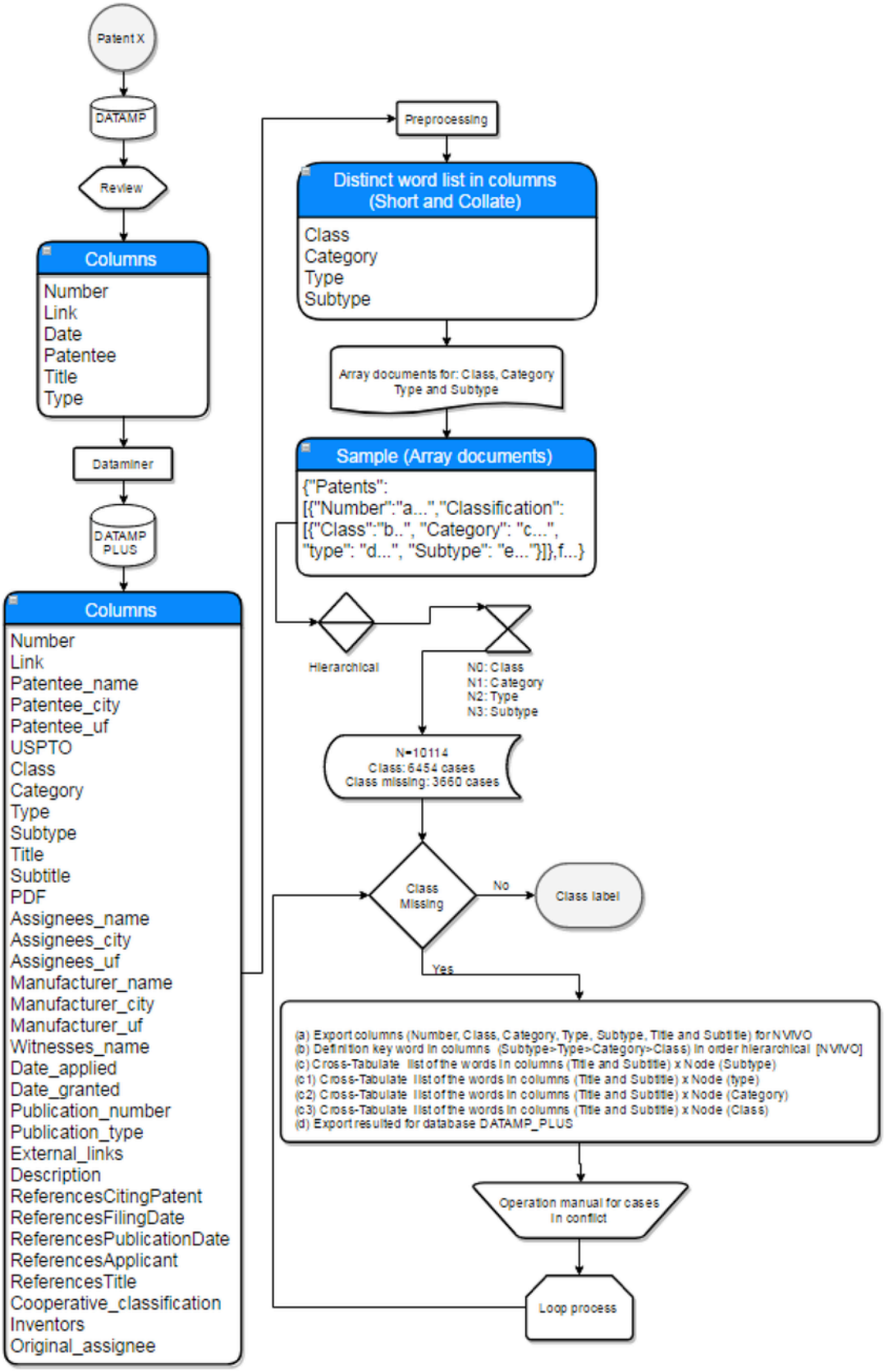


Fig. 8. Simple flow chart of the computing process study applied in this work. Using data mining it was possible to identify the most used words at patent titles and assess new category types, thus identifying the previous not indicated categories using such most used words at the title as new categories applied for other inventions, modifying previous results of Fig. 6*a*.

Table 3
Full information obtained about the first three X-Patents considering DATAMP_Plus. From data mining it was possible to assess the following variables: patent number, link to internet database, full patentee name, subtitle resume, type, subtitle, categories, patentee city, patentee state, classification, assignee(s) name(s), assignee(s) city(ies), assignee(s) state(s), manufacturer name, manufacturer city, manufactures state, witnesses names, date applied, the document in PDF format, publication number, publication type, external links (as the USPTO), descriptions, references citing such patent, references about filling date, references on publications, references on applicants, reference titles, a new cooperative classification, inventors and the original assignee.

Number	1X	2X	3X
Link	http://www.datamp.org/patents/advance.php?pn=1X&id=39617&set=3	http://www.datamp.org/patents/advance.php?pn=2X&id=25299&set=4	http://www.datamp.org/patents/advance.php?pn=3X&id=36919&set=5
Date	Jul. 31, 1790	Aug. 06, 1790	Dec. 18, 1790
Patentee	Samuel Hopkins	Joseph Stacey Sampson	Oliver Evans
Title	Manufacture of pot ash and pearl ash	Manufacturing Candles	Manufacturing flour and meal
Category_Plus	NULL	chandler	miller
Tool_Categories	NULL	[trade specific]; [chandler]	[trade specific]; [miller]
Class_Plus	trade specific	trade specific	trade specific
Procedure_Classifications	Suggestion	Primary	Primary
Patentee_city	Philadelphia	Boston	Philadelphia
Patentee_uf	PA	MA	PA
Classifications	423/208	NULL	NULL
Assignees_name	NULL	NULL	NULL
Assignees_city	NULL	NULL	NULL
Assignees_uf	NULL	NULL	NULL
Manufacturer_name	NULL	NULL	Oliver Evans
Manufacturer_city	NULL	NULL	Philadelphia
Manufacturer_uf	NULL	NULL	PA
Witnesses_name	NULL	NULL	NULL
Date_applied	NULL	NULL	NULL
PDF	http://pimg-fpiw.uspto.gov/fdd/01/000/X00/0.pdf	NULL	NULL
Publication_number	USX1 I1	NULL	NULL
Publication_type	Grant	NULL	NULL
External_links	[USPTO]; [USPTO Assignment]; [Espacenet]	NULL	NULL
Description	<p> XQQQQ Si @s EQ@ <p>	NULL	NULL
ReferencesCitingPatent	[US6127326]; [US6194502]; [US6201053]	NULL	NULL
referencesFilingDate	[Jul 31, 1998]; [Mar 30, 2000]; [May 19, 2000]	NULL	NULL
referencesPublicationDate	[Oct 3, 2000]; [Feb 27, 2001]; [Mar 13, 2001]	NULL	NULL
referencesApplicant	American Ingredients Company	NULL	NULL
referencesTitle	[Partially saponified triglycerides, their methods of manufacture and use as polymer additives]; [Partially saponified triglycerides, their methods of manufacture and use as polymer additives]; [Partially saponified triglycerides, their methods of manufacture and use as polymer additives]	NULL	NULL
Cooperative_classification	C01D3/08	NULL	NULL
Inventors	Samuel Hopkins	NULL	NULL
Original_assignee	Samuel Hopkins	NULL	NULL
Subtitle_resume	 Making pot and pearl ashes	NULL	NULL

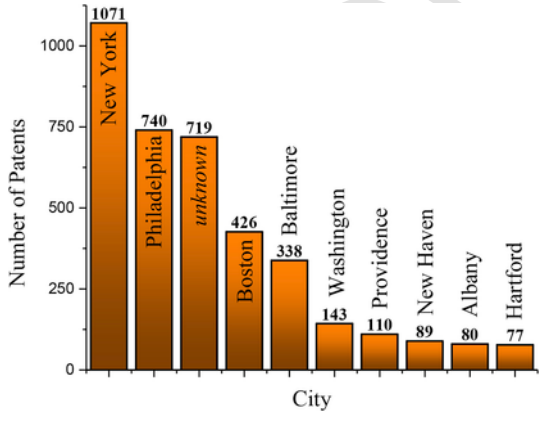


Fig. 9. Ten most prolific patentee's cities during the period 1790-1836 analysed.

It was also possible to identify the patents that were negotiated by some manufacturers, as presented in Table 5. It was also possible to identify the main manufacturers that commercialized such patents.

In Fig. 10 we present a distribution map of the patentee's states. All of them were from the east coast, as expected, due to the American colonization process. Most patentees lived in New York state, followed by Pennsylvania and Massachusetts. This data agrees with the main cities, that were New York and Philadelphia, as presented in Fig. 9. Finally, it was possible to identify all the recovered documents related to the X-Patents - there are 2535 digitalized patent documents available in DATAMP.org. Of this total, there is only significant description in approximately 1400 digitalized patent documents, including the lost fourteen Samuel Morey's patents found recently in the Dartmouth College archives [32]. Descriptively, it can be reported that, so far, no new X-Patents have been restored or partially recovered, which does not significantly alter the previous result of 25%.

Table 4
Examples of some available information of new classifications related to specific X-Patents and respective assignees.

Number	Class_Plus	Title	Assignees
1680X	metalworking machines	Machine for cutting and heading nails	Nathaniel Chickering; Daniel Chickering
3224X	household tools	Locks and latches, etc.	Harvey Durkee
5484X	trade specific	Revolving four barrelled and percussion lock gun	Israel T. Gilson
5894X	trade specific	Milling machine (Screw machine)	Charles Daniels
5945X	trade specific	Calendars	John O. Hara
5978X	trade specific	Twine, seine, and small cordage	Petersburg Manufacturing Co.
6002X	transportation machines	Lifting Ships	Thomas Ballard
6057X	trade specific	Grain scouring	Jesse Neal
6323X	trade specific	Type casting machine	Michael D. Mann; Stephen Sturdevant
6324X	trade specific	Type rubber	Stephen Sturdevant
6949X	agricultural machines	Improvement in plows	Samuel Witherow
7811X	agricultural machines	Tobacco manufacturing	Ashton Johnson
7812X	agricultural machines	Tobacco manufacturing	Ashton Johnson
8109X	structures	Floating dock	James H. Peck; William Thomas; Robert Wash; John D. Coalter
8177X	specialty tools	Extracting fur from skins and manufacturing it into yarn	Levi Ward
8545X	agricultural machines	Cotton press	Isaac Robinson
8668X	metalworking tools	Casting chilled rolls, &c.	McClurg, Parry; Hardy
8680X	household	Shears	John Andrews
8724X	unknown	Fur dressing	Samuel G. Ladd
8726X	household machines	Propelling machinery	Ezra Whitman, Jr.
8794X	trade specific	Balance (Weighing machine)	J. G. Rohr
FX-8952	trade specific	Wool combing	unknown Whitwell
FX-9125	household	Cooking stove	David Gage
9623X	household	Stove	Jonas Kendall
9681X	industrial machine	Extinguisher and heat condenser	Love J. Burr

4. Some landmarks on X-Patents

First, it is relevant to note that President George Washington (in office during 1789–1797) was a strong proponent of the patent system. In his first State of the Union speech to Congress, on January 8, 1790, he declared: "the advancement of agriculture, commerce, and manufactures by all proper means will not, I trust, need recommendation; but I can not forbear intimating to you the expediency of giving effectual encouragement as well to the introduction of new and useful inventions from abroad as to the exertions of skill and genius in producing them at home, and of facilitating the intercourse between the distant parts of our country by a due attention to the post-office and post-roads" [33].

The period of X-Patents historically corresponds to the First Industrial Revolution, that was a transition period from hand production methods to new manufacturing processes, occurred from 1760's to approximately 1830's. These included, among others, new production processes in chemical, textiles and metallurgy manufacturing, improved efficiency of water power (with increasing use of steam power), the development of machine tools and the rise of the industrial system [34]. According to Morris [35], the history of the United States development can be charted as an evolution from local to regional and finally to national networks. More specifically, America emerged as a world economic powerhouse in the 1840s and 1850s, when the railroads finally linked the Northeast and the Midwest, as it was now named, into an integrated industrial and commercial unit. This period is related to the rise of the new American patenting system, initiated in 1837.

It is also important to cite that most of the important technological innovations in America were proposed by foreigners, mainly British, due to language and culture proximities. For example, many horse-powered machinery for small scale applications were proposed, as that made by Luther Carman (8,735FX) on April 2, 1835 (as indicated at Table 1). It is also possible to cite the water-powered milling structure used in Slater's Mill, proposed by the English-American industrialist Samuel Slater (1768–1835): 4,075X, granted on April 04, 1825 - "Machine for Spinning Wool" or the Blanchard lathe, invented by Thomas Blanchard (1788–1864). He produced many innovations – for example, the patent 3,131X ("Turning Irregular Forms"). It is possible to cite, among his inventions, an interesting pattern tracing lathe, a type of shaper that could produce copies of wooden gun stocks of all kinds of irregular forms in a single operation. There is until today an original 1822 equipment at the Springfield Armory Museum [36].

To cite some other key milestones in the American X-Patents, Eli Whitney (1765–1825), of New Haven, patented the cotton gin (72X) on March 14, 1794. This was considered one of the key inventions of the American Industrial Revolution, mainly due to its social and economic impacts. Briefly, Whitney's invention was a mechanical device that removed seeds from cotton, a process that had previously been extremely labor-intensive. The word gin is short for *engine*. Unfortunately, this innovation strengthened the economic foundation of slavery in America, mainly the Southern states. Cotton exports from the United States boomed after the cotton gin's appearance – from less than 85.9 tons in 1791 to 42300 tons by 1810 and 135379 tons by 1830 [37].

An important patent was issued by Nathaniel Briggs (1770–1805) of Keene, New Hampshire, granted on March 28, 1797, about the first American washing machine (160X). He placed an advertisement in a local newspaper concerning his innovation, because he believed that the most difficult part of housework was washing, a duty that was usually undertaken by the "fair sex" [38]. There were 261 X-Patents issued on this subject, according to Fig. 6a, reaching 6th position in this top-10 classification. Laundry has an interesting history that dates back to the Italian polymath Jacopo Strada (1507–1588) and his machine

Table 5
Available information on all X-Patents that were negotiated by manufacturers from DATAMP_Plus database. Table also shows the main manufacturers that commercialized such inventions.

Number	Manufacturers	Manufacturer Name	Class_Plus	Title
5315X	6	Schenck Machine Co., John H. Lester, John Gibson, J. A. Fay & Co., S. B. Schenck, Frank & Prentis	woodworking machines	Machine for planing and tonguing boards
7484X	4	J. A. Fay & Co., Page & Co., T. M. Edwards & Co., Joslin & Fay	woodworking machines	Mortising machine
7714X	4	Joslin & Fay, J. A. Fay & Co., Page & Co., T. M. Edwards & Co.	woodworking tools	Cutting and clearing chisel
8957X	4	T. M. Edwards & Co., Page & Co., Joslin & Fay, J. A. Fay & Co.	woodworking tools	Improved cutting and clearing chisel
1114X	2	L'Hommedieu & Watrous Co., Ezra L'Hommedieu	woodworking tools	Double podded central screw auger
7252X	2	Findlay Steam Engine Manufactory, Gideon Hotchkiss	propulsion and energy	Water wheel
7560X	2	James Hamilton, R. Hoe & Co.; James Hamilton	trade specific	Making fellies
9445X	2	R. Hoe & Co., Setn & Isaac Adams	specialty machines	Power printing press
FX-7281	2	Gideon Hotchkiss, Findlay Steam Engine Manufactory	propulsion and energy	Water wheel
1515X	1	Hall's Rifle Works	armaments	Firearms
1516X	1	Hall's Rifle Works	armaments	Firearms
170X	1	Williams, Whittemore & Co.	trade specific	Machine for the Manufacture of Sheet Cards
2331X	1	Pomroy & Hedge	rules	Spring Pen Ruler
2642X	1	Ezra L'Hommedieu	woodworking tools	Single twist screw auger
2746X	1	Pomroy & Hedge	rules	Revolving ruler
304X	1	John J. Hawkins	trade specific	Musical instruments
3131X	1	James L. Haven & Co.	woodworking machines	Machine for turning gun stocks
3213X	1	Daniel Tomlinson	specialty tools	Currying Knife
3709X	1	E. Carver Co.	agricultural machines	Making saws and grates for cotton gins
3710X	1	E. Carver Co.	agricultural machines	Cotton gins
3X	1	Oliver Evans	trade specific	Manufacturing flour and meal
4687X	1	J. Bayne	layout tools	Tailor's Measure
4799X	1	The Stanley Rule & Level Co.	woodworking machines	Engine for dividing scales, gauges, etc.
4859X	1	Savage Manufacturing Co.	woodworking tools	Plane stocks of cast iron
4943X	1	John Iggett	household	Warming and heating rooms
5077X	1	Hubbard & Co.	water distribution systems	Revolving hydraulic engine
5675X	1	Ephraim Morris	transportation machines	Raising and lowering boats on canals by an inclined plane
5838X	1	Martin Rich	woodworking machines	Dog irons
5915X	1	Martin Rich	woodworking machines	Dog irons
5993X	1	H. Aiken	woodworking tools	Saw-set
6178X	1	R. Hoe & Co.	specialty machines	Printing press
6707X	1	Jonathan Hobbs, Jr.	woodworking machines	Sawing shingles, &c.
6737X	1	Fay & Fisher	woodworking machines	Tenoning machine
6913X	1	Gideon Hotchkiss	agricultural machines	Grist mill
7254X	1	Homer Foot	wrenches	Wrench
7416X	1	Martin Rich	woodworking machines	Saw mill dogs
7730X	1	James MacGregor, Jr.	woodworking machines	Planing machine
7951X	1	Isreal White	woodworking tools	Bench Plane
8048X	1	Martin Rich	woodworking machines	Saw mill dogs

Table 5 (*Continued*)

Number	Manufacturers	Manufacturer Name	Class_Plus	Title
8100X	1	J. W. Bliss	woodworking machines	Mortising machine
813X	1	Ramapo Iron Works	trade specific	Hoop and sheet iron
8291X	1	J. Howe	woodworking tools	Hammer and hatchet
8327X	1	Gideon Hotchkiss	agricultural machines	Thresher
8548X	1	Thomas E. Daniels	woodworking machines	Plane attachment
8680X	1	Rochius Heinisch	household	Shears
8715X	1	Martin Rich	woodworking machines	Lever sawmill dog
8721X	1	Pearson Crosby	woodworking machines	Reciprocating sawmill
8725X	1	Martin Rich	woodworking machines	Dog gauge saw mill
8783X	1	S. Morton Clark & Co.	rules	Carpenter's rule joint
8972X	1	Edward K. Reynolds	woodworking machines	Bending wood
9030X	1	Bemis & Call	wrenches	Wrench
92X	1	Jacob Perkins	metalworking machines	Nail Machine
9439X	1	Martin Rich	woodworking machines	Saw mill dogs
9696X	1	Gideon Hotchkiss	propulsion and energy	Art of propelling or drawing boats (towing)
9814X	1	Wilson Manufacturing Co.	woodworking tools	Bit stock
XC-152	1	Martin Rich	woodworking machines	A certain apparatus to be attached to saw mills

Fig. 10. Distribution of the most productive patentee's states during the period 1790-1836 analysed.

drawings, including milling and a possible wash machine published by his son, Ottavio Strada (1550–1607) [39]. The English inventor John Tizack has issued on August 22, 1691, the *GB* 271: "A way by an engine to be worked by one or "more men for the well & more easy oyling & dressing of leather & cloth; " and which engine, it is said, may be of great use also to other trades; and among other purposes, of which there are a number given, it may be used for "pounding and making raggs fitt to make paper and the like" [40].

An interesting innovation was issued by the Irish engineer and judge James Finley (1756–1828) on June 17, 1808: patent 883X. He was the first designer and builder of the modern suspension bridge. One of the first to receive a patent for a bridge was the Philadelphia portrait painter, soldier, politician, inventor and museum keeper Charles Willson Peale (1741–1827), with his 148X patent, in January 21, 1797.

The patent 965X, issued by James P. Parke of Philadelphia on December 19, 1808, was for an alarm bell attached to fire engines. The bell was attached using a spring so that it rang either by the power of the wheels or by vibration [5].

The first woman to issue a X-Patent was Mary Dixon Kies (1752–1837). She innovated a new technique of weaving straw with silk and cotton threads to make hats, published on May 5, 1809 (patent 1,041X: "Weaving straw with silk or thread"). Its innovation made possible to produce beautiful straw hats and bonnets. However, she was unable to make a commercial success of such straw-weaving process. Her patent was probably signed by President James Madison, Jr. (1751–1836).

However, the first American patent-holder was Sybilla Masters (*née* Righton, *c*.1676–1720). In fact she was the first person residing in the British Colonial America to be given an English patent [41]. On November 25, 1715 she, as the wife of colony's governor of Pennsylvania, requested and obtained, under number *GB* 401, an English patent on processing corn flour more clean and efficiently using hammers instead of mills: "Cleaning and Curing the Indian Corn Growing in the Several Colonies of America" [42]. However, since women were not allowed to apply for patents in that colonial era, her invention was credited on behalf of her husband by King George I (1660–1727): "Thomas Masters, Planter of Pennsylvania, for an invention found by Sibylla, his wife, for cleaning and curing the Indian Corn growing in several colonies in America". Thus, Sybilla Masters obtained a similar privilege of invention for a second patent application the following year - on "a new way of working and staining in straw, and the plant, and the leaf of the palmetto tree, and covering and adorning hats and bonnets in such a manner as was never before done or practiced in England or any of our plantations.

A curious innovation was the world's first small alarm clock, an ingenious chamber alarm bell, issued to Benjamin E. Freymuth of Philadelphia, on December 22, 1814 (2,244X). The alarm was achieved

by coiling a ribbon around a spring wheel, which was released as a pocket watch turns to a certain point. Other example was well-know medicine, liquid magnesia, issued to John Cullen on May 4, 1818 (2,952X).

Another interesting innovation was proposed by Levi Spear Parmly (1790–1859) on June 17, 1820: "Composition for Cleansing and Preserving Teeth", 3,209X. Under this patent, he introduced flossing as the most efficient way to prevent dental disease, using silk floss [43].

Following 1793 Patent Act and the current American laws, they declared that "the master is the owner of the fruits of the labor of the slave both manual and intellectual" [44]. Thus, no slave could patent his own inventions, because if they intended, patents would be considered property of their owner.

However, there was a descendant of slaves who submitted a patent on March 3, 1821, and was able to obtain the application, under number 3,306X. The required patent was about "Dry Scouring Clothes", that was a new method of cleaning and washing that preceded the dry cleaning current system.

The patent applicant was Thomas L. Jennings (1791–1856), tailor, entrepreneur, inventor and abolitionist, a free man [45]. That was the reason why he obtained exclusive rights and the patent privilege of a new process. But this was not an easy task, because his request was contested due the fact of being black. Jennings won the case because the law simply was not applicable to him. It was only in 1861 that the American Congress reviewed the rules to extend patent rights to slaves, since the new law understood that the privilege should be granted "only to its one true inventor," even if they were still considered to be a property of someone.

The American inventor Samuel Morey (1762–1843) of Orford, Grafton County, New Hampshire, one of top ten X-Patentees (see Fig. 5) worked on the early internal combustion engine (4,378X, granted on April 1, 1826) [46]. He was also a pioneer in steamships who accumulated a total of 19 patents. His first innovation was a steam-powered rotating spit for cooking meat (51X: "Improvement in Turning a Spit"), granted on January 29, 1793.

The first American patent of a typographer (5,581X), a kind of typewriter, was issued to the American inventor William Austin Burt (1792–1858) on July 23, 1829. This patent was signed by President Andrew Jackson (1767–1845). However, this was not the first patent in the world related to a typewriter, that was issued to Henry Mill (*c.* 1683–1771), an English engineer and inventor, by Queen Anne as *GB* 395 in 1714: "Machine for Transcribing Letters" [47]. Another curious innovation was proposed by Joseph Nicolas on June 13, 1831, about a method of exterminating insects in fields by spraying steam on them – the invention expected that the action of heat would spread or even kill all them. Another impressive innovation was issued by William Atkinson and Ebenezer Hale, both of New York, on December 2, 1835, for a method of raising sunken ships by filling them with inflated bags (9,274X).

It is important to cite that the American inventors Solyman Merrick (1806–1852) and Samuel Colt (1814–1862) had the following patents issued: 8,153X on April 18, 1834 ("Wrench") and 9,430X on February 25, 1836 ("Revolving Gun", a six-shooter), respectively. Colt received his first granted patent in UK (*GB* 6,909, "Certain Improvements Applicable to Fire Arms", on October 22, 1835). Finally, Hiram Moore (1817–1902) and John Hascall (1785–1853), both from Kalamazoo, Michigan, proposed the first *harvesting* machine (9,793X) on June 28, 1836. This innovation is still in use, because it is a machine that combines the tasks of harvesting, threshing, and cleaning grain crops. The objective is to complete all these three processes, which used to be distinct, in one pass of the machine over a particular part of the field.

Fig. 11 resumes some landmarks covering almost half a century of the X-Patents. Fascinated with new scientific discoveries and technological apparatus, and probably with some of these innovations in mind, President Abraham Lincoln (1809–1865) wrote an interesting speech on discoveries and inventions around 1858/1859: "the patent system … secured to the inventor, for a limited time, the exclusive use of his invention; and thereby added the fuel of interest to the fire of genius, in the discovery and production of new and useful things" [33].

5. Conclusions

Patents are of unquestionable importance to the study and understanding of the science's and technology's history. Patents issued under the Patent Acts of 1790 and 1793 were not assigned numbers. Instead, they were referred to the name of the inventor and date of issue. All the first ten thousand American innovations are known as the X-patents. The first patents were issued from July 1790, when the United States patent system was created under an order signed by George Washington, to July 1836, when every one of them burned in a great fire on December 15, 1836, that destroyed the Patent Office and most of its records (around 75%). In this period there were 6963 inventors. The first ten patents were issued by patentees from two different places: Philadelphia city or the State of Massachusetts, both populous at that time.

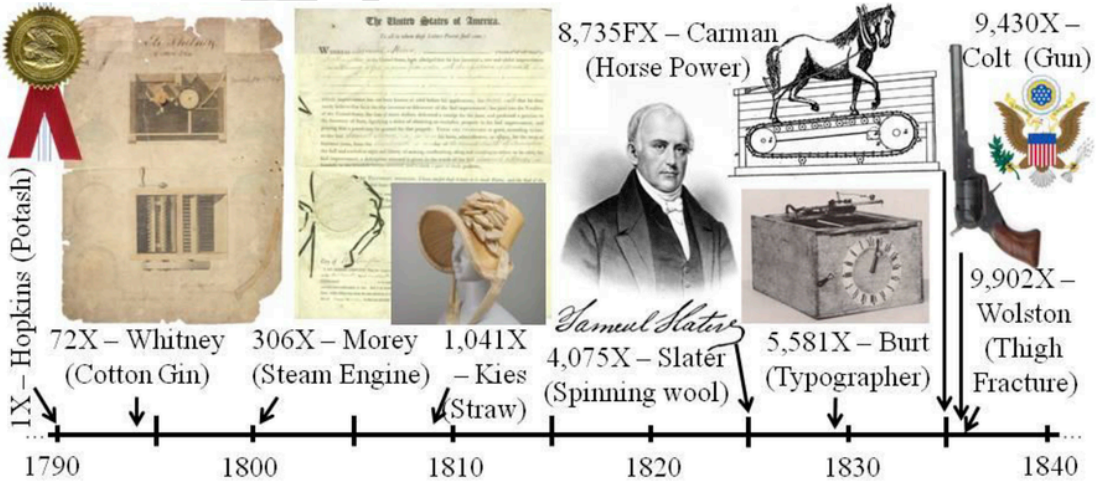


Fig. 11. Timeline of some X-Patent landmarks from 1790 to 1836 cited in this work, including the first and last X-Patents.

The US Patent Office began numbering patents issued under the Patent Act of 1836; Patent No. 1 was issued on July 13, 1836. Since the first American patents, the United States Patent and Trademark Office (USPTO) has granted more than nine million patents and almost eight million trademarks prior to 2015. We have presented the evolution of the patent system considering data starting in the 1790 up to 1836, showing new results considering data mining applied to a public and free patent database. It is possible to affirm that some advances in modern science and technology are strongly connected to X-Patents, as for example the cotton gin, washing machines and steam engines. This new patent system promoted the industrial independence from Europe. Today, to be granted, every American patent should surpass the three tests of patentability: novelty, usefulness, and non-obviousness. There were officially 9902 X-patents granted from 6963 inventors, but some more were included due to assigned duplicate numbers that now are considered "fractional patents", or even not numerated. For sure, the history of the America's rise from its agrarian roots through today's technological age is also due to innovations from the first patentees. All such X-Patents supported the American Industrial Revolution because it was standing on the shoulders of brilliant inventors.

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