RetroChallenge 2022/10
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October 1, 2022

Episode 0: The Punch-Card Medium

When we start talking about "punch cards" as a medium for data storage, it would be logical (and chronological) to start with the invention of the Jacquard Loom, or perhaps the earliest glimmerings of electronic data processing during the interval between the 1880 census and the 1890 census. That would tie-in nicely with the foundation of IBM ("The" Computer Company for most of the 20th Century.) We could talk about Herman Hollerith and prior art dating back to Charles Babbage. Nope. That's too easy. Let's talk about an event that was, perhaps, the last time that punched cards intruded on the public's consciousness: the United States General Election in November 2000.

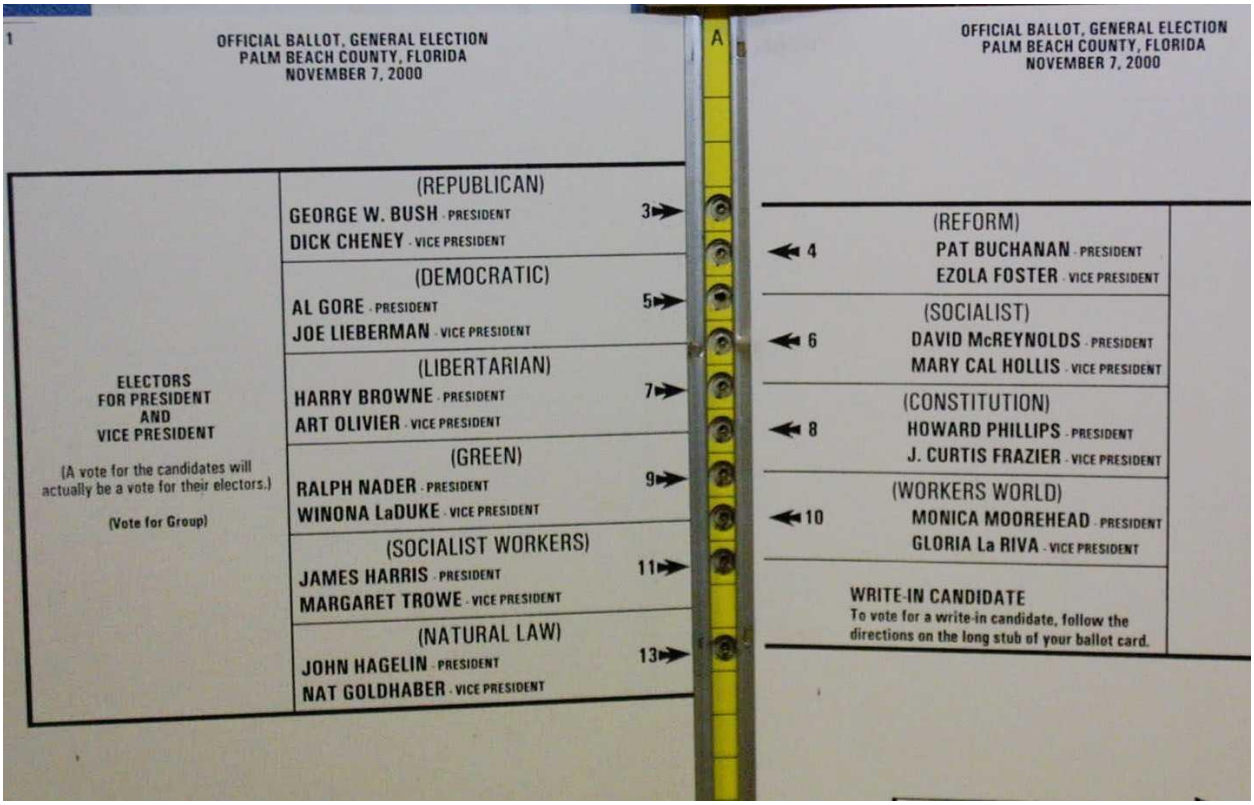
We began the year 2000 with a crisis appropriate for folks interested in RetroComputing: The much-anticipated Y2K problem. The theory was that computer systems (both hardware and software), which by that time had become completely indispensable in every business, had been subtly designed for failure by representing dates (almost exclusively) using a two-digit string accounting for the ordinal years since 1900. What would happen when the dates "rolled over" to zero on January 1, 2000? Some predicted widespread failures of everything from Credit Cards, Bank Accounts, Mortgage Instruments, Medical Equipment, and even the tiny little microcontrollers embedded in things like gasoline dispensers and insulin pumps. Could the software and hardware be updated in time?

Some of us with a deep background in low-end application programming snickered a little bit, raised our hourly rates, and managed to pay off our 30-year mortgages in a frenzied season of updates to ancient COBOL programs and Microsoft Jet database systems. We updated a few functions, tweaked the length of a few database fields, and called it a day. All is now good until the end of the Unix epoch on January 19, 2038 at 03:14:08 UTC. Hopefully, by then it will be somebody else's problem!

While the Y2K bug ended up being a fairly minor inconvenience for a few businesses, the general election on November 7, 2000 became a cluster-fuck of biblical proportions when a poorly-designed and

executed "butterfly" ballot based on punch-card technology became the subject of a dispute over the results of the popular vote in Florida. The dispute hinged on an exceptionally close race between Al Gore (Democrat) and George W. Bush (Republican.) The final tally awarded the 25 electoral votes for Florida to Bush with a popular vote margin of 0.009% and a raw count of 537 more popular votes than Gore.

The aftermath of the general election involved multiple automated and manual re-counts of the vote. We heard various talking heads and election officials talk about "over-votes" and "under-votes." We heard descriptions of "hanging chad" and "pregnant chad." We looked at endless hours of video tape depicting hapless election judges examining paper ballots with a magnifying glass in an attempt to ascertain whether or not a particular hole was completely punched out, or whether deformation of the ballot indicated an attempt to vote for one candidate or the other.



In fact, the "butterfly ballot" was a perfect example of something designed by committee. It was printed using large type in an attempt to satisfy the needs of the visually impaired. The holes, representing the user's vote for a particular candidate, were perforated so that the chad could be pushed out using a blunt stylus. The ballot was intended to be used in a low-cost plastic fixture that collected the chad and provided a firm surface with

impressions for punching the ballot. Nothing could be simpler! Your vote is a single hole in a paper ballot.

Unfortunately, the ballot proved to be confusing to many residents in the great state of Florida. Some folks were confused by the use of a vertical column of potential holes with alternating left-and-right hand political parties and candidates. Some attempted to punch out holes using a pencil, instead of the intended stylus. Some failed to place the ballot properly in the plastic fixture. Others made multiple selections for an office with a single-possible vote. It ended up being quite the mess. Ballots, intended for tabulation by machine, could not be read. Ballots were manually counted and inspected. Multiple recounts were made. In the end, the election was decided by the United States Supreme Court on December 12, 2000 in "Bush versus Gore." Bush became the President of the United States and served two four-year terms ending in 2009. Gore retired from politics. Democrats claimed a stolen election, and punch cards took the rap for being an archaic medium for data entry and storage.

Actually, the faults of punch-card systems for data entry and data storage were well-known in the first half of the 20th century, long before the results of a Presidential Election hinged on the presence or absence of a perforation at a particular location on a piece of cardstock. Punch cards were *terrible*, as anybody who ever dropped a deck of cards containing their program could attest. Cards were fragile, dimensionally unstable, jammed the equipment, could easily be torn and folded, and had exceptionally low storage density. Remember, a single card could hold only 80 characters, or 960 bits of information, on a 3 ¼" x 7 3/8" form of 23.97 square inches.

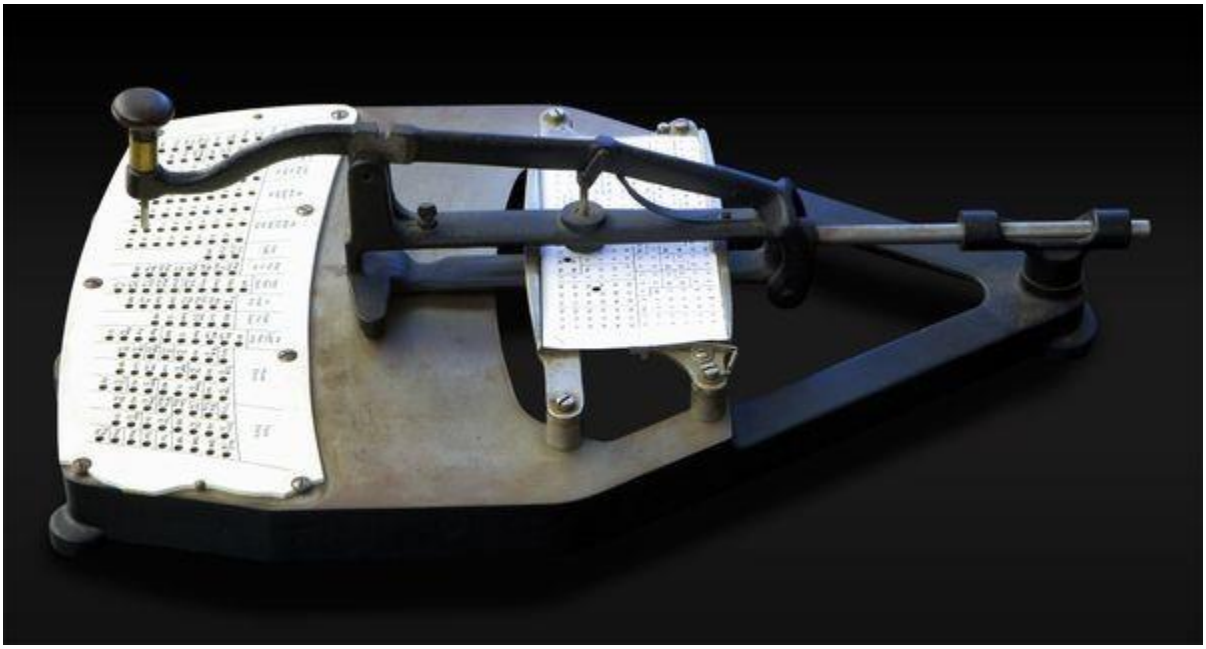
Really, the two ideas that made punch-cards better than contemporary alternatives (like punched paper tape) were the concept of the "unit record" and the related concept of the "clutch cycle."

The first concept, that of the "unit record" meant that a single card was intended to store a single element of data - one record holding a person's home address, for instance; one transaction; or one data point in a large database. Processing a file containing multiple unit-records made the production of reports a likely candidate for automation and "hands off" tabulation. In an original punch-card application, the United States Census of 1890, each card represented one person with multiple bits of demographic information recorded on that single card. A small collection of

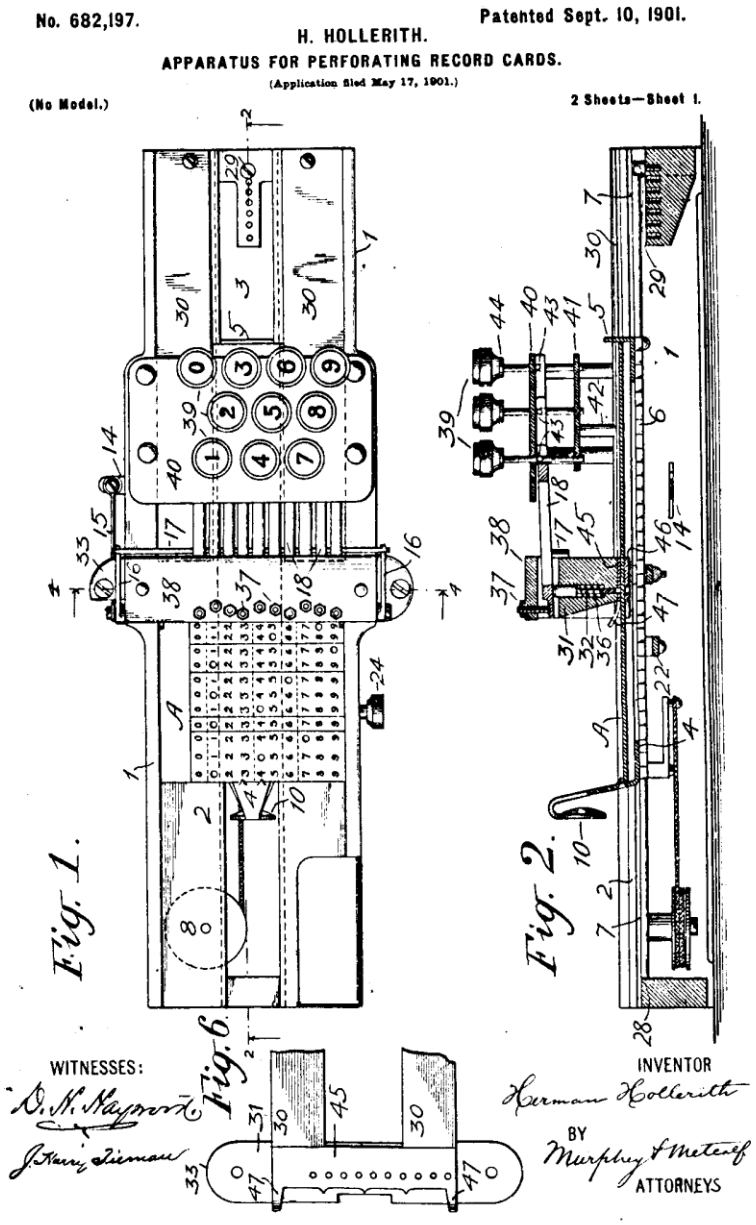
those cards represented a household. A few more represented a neighborhood. A few hundred represented a village or ward of a larger city. Thousands might represent an entire City; hundreds of thousands correspond to a county. A few million represents a state or a territory. Finally, the entire nation could be reduced to around 63,000,000 punch cards back in 1890.

At the time, most cards (and systems) were a bit different than the "standard IBM Card" we are used to dealing with. The first cards were marked with a standard hole-punch used to answer simply yes-or-no questions arranged along the edges of the card. Cards could be sorted or selected using a blunt set of instruments similar to knitting needles. This very basic system was still in use when I went to college. Various brands included Cope-Chat cards, E-Z Sort cards, McBee Keysort, and Indecks cards. I had a professor in a Database Class that insisted on prototyping every database with these purely manual systems. If you couldn't select records or sort the entire database with something as simple as a 5x8 edge-punched card, you needed to rethink the organization of your database.

The early Hollerith Systems used more real estate on each card, with up to 40 categories of information encoded in a matrix of 12 rows by 24 columns. Each card was 3" x 5.5" and could hold a maximum of 288 bits of information. The limit of 40 different categories was established by the number of electrical counters on the tabulating machine. Related equipment, such as the electrical sorting box, allowed for filing of punch cards based on the information encoded thereon.



While early cards were punched using a standard "ticket punch", operators often had difficulty punching holes located near the center of the card. Hollerith created the "pantograph" punch to enable more accurate placement of the holes. Later developments included the manual (and later electrically driven) keypunch.


No. 682,197. Patented Sept. 10, 1901.

H. HOLLERITH.

APPARATUS FOR PERFORATING RECORD CARDS.

(Application filed May 17, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

Fig. 2.

Fig. 6.

WITNESSES:

INVENTOR

Hermann Hollerith

BY

Murphy & Metcalf

ATTORNEYS

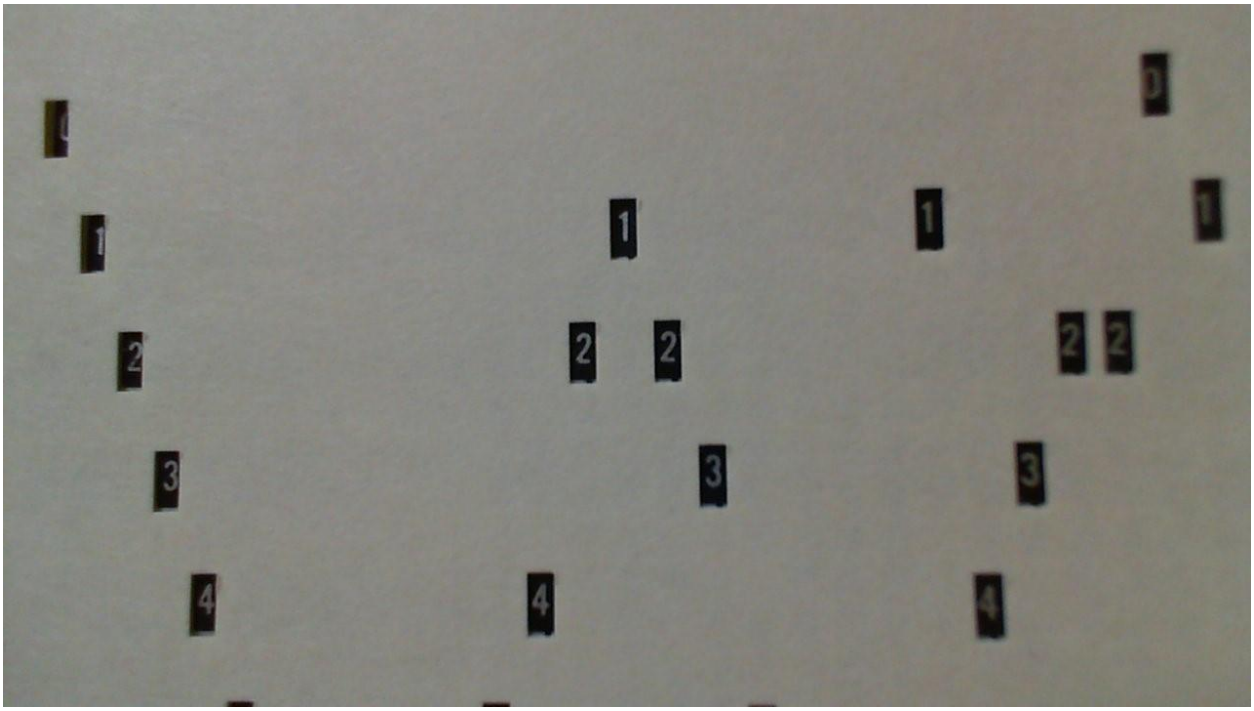
The keypunch I'll be using for the bulk of this Retrochallenge is remarkably similar to the Hollerith Machine described here. Actual

IBM equipment of this vintage is rather expensive, but other manufacturers found a market for portable, inexpensive card punches for use with offline data entry and emergency "repairs" to damaged punch cards. I have a much larger IBM 024 electrical keypunch that was the subject of an earlier Retrochallenge. I was sadly unable to get that machine working at the time due to damaged vacuum tubes and selenium rectifiers, but I might revisit that machine this month as well.

This machine is a portable manual keypunch much like the Hollerith machine seen on the last page. This uses "standard" IBM Tab Cards with the dimensions of 3 ¼" High by 7 3/8" Long with a nominal thickness of 0.007". There are 12 vertical rows x 80 horizontal columns, and each card can hold 80 characters or 960 binary digits. Alphabetic characters and punctuation are encoder by pressing one or more keys simultaneously, and the appropriate character codes are noted on the punch assembly immediately adjacent to the keyboard.

I'm fortunate to have such a machine on-hand, and even more fortunate in that its rugged mechanical design has very little to go wrong. As such, despite an age of 55 years, this machine works almost like new, requiring nothing more than a superficial cleaning and lubrication with "3-in-One" oil to get it working. The ratchet assembly guiding the carriage and rigid metal structure securing the punch knives has maintained perfect registration over the years, and cards punched on this machine match up perfectly with the official IBM Card Gauge intended for

troubleshooting the much more complex 024/026/029 card punches from the same era.



One problem the user of punch-cards is inevitably going to run into is the availability of punch cards. The last two sources (other than eBay) for new un-punched tab cards were the U.S. Card Corporation of Tiffin, Ohio and the California Tab Card Company of Whittier. Both were gone by 2016. I'm also fortunate to have a quantity of card stock that has been die-cut to the approximate dimensions for IBM punch cards, but lacks the diagonal corner cut and the radius-cut on the remaining three corners.