Konrad Zuse's Computer Patents

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After Charles Babbage's "Analytical Engine" [1][2] and Percy Ludgate's "Analytical Machine" [3][4][5][6], a third mechanical design emerged at the dawn of the electronic computer era in 1936, Konrad Zuse's "V1", later renamed "Z1" [7]. Thereafter his subsequent designs, and particularly the Z3 (1941) [8],[4] were electromechanical. He applied for many patents on his computing inventions. See Table 1 for a summary of Zuse's German patent applications, and the references for complete details of patent numbers, dates and outcomes. In the same vein see Table 2 for his Austrian patent applications.

Year	Title (translated)	Granted	See Reference
1936	*Procedure for the automatic execution of calculations with the aid of calculating machines*	—	[9]
1936	*Calculating machine*	—	[10]
1936	*Mechanical switching element*	1953	[11]
1937	*Mechanical distribution switchgear*	1954	[12]
1937	*Storage mechanism constructed from mechanical switching elements*	1954	[13]
1941	*Calculating device [based on Z3]*	—	[14]
1943	*Method for scanning surfaces and device for carrying out the method*	1953	[15]
1944	*Method of multiplying numbers*	—	[16]
1944	*Device for deriving result data by means of basic operations of the propositional calculus*	—	[17]
1947	*Device for deriving result data by means of basic operations of the propositional calculus*	1952	[18]
1950	*Combined numeric and non-numeric calculator*	1955	[19]

Table 1: Konrad Zuse's German patent applications (transl.)

Year	Title (translated)	Granted	See Reference
1947	*Device for deriving result data by means of basic operations of the propositional calculus*	—	[20]
1949	*Dyadic calculating device*	1953	[21]
1949	*Calculating device, punched-card machine or similar*	1953	[22]

Table 2: Konrad Zuse's Austrian patent applications (transl.)

Zuse travelled a long and ultimately unsuccessful path with many of his patent applications. For example, Zuse first registered the principle of the Z3 under the title "*Calculating device*" with the Reich Patent Office on 16th June 1941, when it was given the file number Z26476 IXb/42m [14]. Only one drawing of the Z3 survived the Second World War, the machine itself being destroyed in a bombing raid. Zuse escaped from Berlin, bringing his only surviving machine, his Z4, with him to Bavaria. Probably due to World War II, the application was not processed to a conclusion. After World War II the German Patent Office was reorganised, and hence from November 1951, he revived his attempt to obtain this patent, which was renumbered Z391, but to his very evident frustration, this application then followed a difficult and tortuous trajectory, and only in mid-1967, twenty-six years after filing the patent, was a final decision made by the German Patent Office, and then to reject the application. The role in this of Percy Ludgate's 1909 paper is discussed in [23].

All of the Zuse patent litigation documentation, and almost all of the literature about it, is in the German language. The microfilm images of the litigation documents are published online by the Konrad Zuse Internet Archive [24][25][26]. The most extensive literature about the litigation is the excellent German-language account given by Hartmut Petzold's chapter "*Die Mühlen des Patentamts*" ("*The Mills of the Patent Office*") in Raul Rojas' very

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4 An excellent detailed account of the design of the Z3, and of the technical details in Zuse's patent application, has recently been provided by Rojas [8].

illuminating book "*Die Rechenmaschinen von Konrad Zuse*" [27]. For an account of how Percy Ludgate's 1909 paper helped in this litigation to thwart Konrad Zuse's Z3 computer patent in 1960, see [28].

References:

[1] Ada Lovelace, *Sketch of the analytical engine invented by Charles Babbage, esq. by L.F. Menabrea, of Turin, officer of the military engineers, with notes by the translator*, in Richard Taylor (ed.), Scientific memoirs (London, 1843), vol. 3, 666–731. Also see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/lnk501.html

[2] Major-General H. P. Babbage, *The Analytical Engine*, Proc.British Association, 1888 (paper read at Bath, September 12, 1888). Also see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/lnk502.html

[3] Percy E. Ludgate, *On a proposed analytical machine*, Scientific Proceedings of the Royal Dublin Society, Volume 12, Number 9, Dublin, 28th April, 1909, pp. 77–91. Also see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/lnk401.html

[4] P. E. Ludgate, *Automatic calculating machines*, in, Ellice Martin Horsburgh (ed.), *Napier Tercentenary Celebration: Handbook of the Exhibition* (also published as *Modern instruments and methods of calculation*), London, 1914, pp. 124–7. Also see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/lnk407.html

[5] The John Gabriel Byrne Computer Science Collection, *Investigating Percy Ludgate and his Analytical Machine (Ludgate page)*, see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/

[6] Brian Coghlan and Brian Randell, *Percy Ludgate (1883-1922): Ireland's First Computer Designer*, pp.1-246, John Gabriel Byrne Computer Science Collection, 2022, ISBN: 978 1911 566 298.

[7] Konrad Zuse, *The Computer – My Life*, Springer-Verlag, Heidelberg, 1993, ISBN 0-387-56453-5.

[8] Raul Rojas, *Konrad Zuse's Early Computers: The Quest for the Computer in Germany (History of Computing)*, pp.249, Springer, 14 October 2023, ISBN: 978-3031398759.

[9] Konrad Zuse, *Verfahren zur selbsttätigen Durchführung von Rechnungenmit Hilfe von Rechenmaschinen (Procedure for the automatic execution of calculations with the aid of calculating machines*), Patent Application Z23139 IX/42m, German Patent Office, 11h April 1936, withdrawn August 1940.

[10] Konrad Zuse, *Rechenmaschine (Calculating machine)*, Patent Application Z23624 IXb/42m, German Patent Office, filed 21st December 1936, withdrawn February 1943.

[11] Konrad Zuse, *Mechanisches Schaltglied (Mechanical switching element)*, Patent Application Z23189 (Z396) IXb/42m, German Patent Office, filed 9th May 1936, published 18th September 1952, granted 10th September 1953, waiver of 23rd August 1955.

[12] Konrad Zuse, *Mechanisches Verteilerschaltglied (Mechanical distribution switchgear)*, Patent Application Z23967 (Z397) IXb/42m, German Patent Office, filed 2nd July 1937, published 18th December 1952, granted 22nd July 1954, waiver of 23rd August 1955.

[13] Konrad Zuse, *Aus mechanischen Schaltgliedern aufgebautes Speicherwerk (Storage mechanism constructed from mechanical switching elements)*, Patent Application Z24062 (Z395) IXb/42m, German Patent Office, filed 2nd July 1937, published 18th June 1953, granted 29th November 1954, waiver of 23rd August 1955.

[14] Konrad Zuse, *Rechenvorrichtung (Calculating device)*, Patent Application Z26476 (Z391) IXb/42m, German Patent Office, filed 16th June 1941, published 4th December 1952.

[15] Konrad Zuse, *Verfahren zur Abtastung von Oberflächen und Einrichtung zur Durchführung des Verfahrens (Method for scanning surfaces and device for carrying out the method)*, Patent Application Z28222 (Z392) IXb/42m, German Patent Office, filed 2nd October 1943, published 3rd July 1952, granted 26th February 1953.

[16] Konrad Zuse, *Verfahren zum Multiplizieren von Zahlen (Method of multiplying numbers)*, Patent Application Z28571 (Z393) IXb/42m, German Patent Office, filed 16th May 1944, published 28th February 1952.

[17] Konrad Zuse, *Vorrichtung zum Ableiten von Resultatangaben mittels Grundoperationen des Aussagenkalküls (Device for deriving result data by means of basic operations of the propositional calculus)*, Patent Application Z28780 (Z394) IXb/42m, German Patent Office, filed 11th October 1944.

[18] Konrad Zuse, *Vorrichtung zum Ableiten von Resultatangaben mittels Grundoperationen des Aussagenkalküls (Device for deriving result data by means of basic operations of the propositional calculus)*, Patent Application A1526/47, German Patent Office, filed 2nd February 1947, granted 1st July 1952.

[19] Konrad Zuse, *Kombinierte numerische und nichtnumerische Rechenmaschine (Combined numeric and non-numeric calculator)*, Patent Application Z530 IXb/42m, German Patent Office, filed 13th May 1950, granted 17th March 1955.

[20] Konrad Zuse, *Vorrichtung zum Ableiten von Resultatangaben mittels Grundoperationen des Aussagenkalküls (Device for deriving result data by means of basic operations of the propositional calculus)*, Patent Application AT 172 288, Austrian Patent Office, filed 2nd April 1947, published 25th August 1952. See: https://depatisnet.dpma.de/DepatisNet/depatisnet?action=pdf&docid=AT000000172288B
NB: Logic machine, distant relative of Edmund Berkeley's *Simon* relay calculator. The device is also listed by Petzold as a German patent for 1944 and 1947. The 1947 entry is strange as at that time the patent office was closed.

[21] Konrad Zuse, *Dyadische Rechenvorrichtung (Dyadic [Binary] calculating device)*, Patent Application AT 176 686, Austrian Patent Office, filed 24th May 1949, patented 15th April 1953, published 10th November 1953. See: https://depatisnet.dpma.de/DepatisNet/depatisnet?action=pdf&docid=AT000000176686B
NB: Mechanical computer, basically.the Z1 patent. The equivalent German patent was DE 962 654, applied for and patented 31st May 1949, published 30th April 1952, as *Rechenvorrichtung zum Darstellen einer oder mehrerer Funktionen*. In May 1949 the German Patent Office was still closed but it may have accepted applications; it opened again in October 1949.

[22] Konrad Zuse, *Rechenvorrichtung, Lochkartenmaschine od. dgl. [oder dergleichen] (Calculating device, punched-card machine or similar)*, Patent Application AT 176 994, Austrian Patent Office, filed 29th June 1949, patented 15th May 1953, published 10th December 1953. See: https://depatisnet.dpma.de/DepatisNet/depatisnet?achon=pdf&docid=AT000000176994B
NB: Possibly related to the M9 punched-card machine for Remington Rand Switzerland. The equivalent German patent was DE 975 966, applied for and patented 30th June 1949, published 20th March 1952, as *Rechenmaschine zur Durchführung von arithmetischen Rechenoperationen*. Note that in June 1949 the German Patent Office still closed but it may have accepted applications; it opened again in October 1949.

[23] Brian Coghlan, Brian Randell, Ralf Buelow, *How Percy Ludgate's 1909 paper helped thwart Konrad Zuse's Computer Patent in 1960*, IEEE Annals of the History of Computing, submitted for publication, 6th December, 2023.

[24] Konrad Zuse Internet Archive, see: http://zuse.zib.de

[25] Konrad Zuse Internet Archive, *Zuse patent litigation archive*, see: http://zuse.zib.de/collection/BewakKVf30YcY53B/item/6CUfMX2RuO0KpmUo
Also, see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/lnk603.html

[26] Deutsches Museum, *Zuse patent litigation archive*, see (browse with the arrows beneath):
https://digital.deutsches-museum.de/de/digital-catalogue/archive-item/NL%2520207%252F0980/
https://digital.deutsches-museum.de/de/digital-catalogue/archive-item/NL%2520207%252F0981/
https://digital.deutsches-museum.de/de/digital-catalogue/archive-item/NL%2520207%252F0982/
https://digital.deutsches-museum.de/de/digital-catalogue/archive-item/NL%2520207%252F0986/

[27] Hartmut Petzold, *Die Mühlen des Patentamts*, pp.63-108, In: Raúl Rojas (Ed.), *Die Rechenmaschinen von Konrad Zuse*, 221pp., Springer, Heidelberg, 1998. For English translation (2023) see: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/lnk611.html

[28] Brian Coghlan, Brian Randell, Ralf Buelow, *"How Percy Ludgate's 1909 paper helped thwart Konrad Zuse's Computer Patent in 1960"*, accepted for publication by the IEEE Annals of the History of Computing, 2024.