

THE RESURRECTION OF THE WIEGAND-WIRE



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**"THE SUCCESS OF ENERGY
HARVESTING SOLUTION"**

DR. THOMAS THEIL

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HISTORY

Patent of John R. Wiegand in June 1974

Barkhausen: 1919
Sixtus & Tonks: 1930

United States Patent [19] Wiegand

[11] **3,820,090**
[45] **June 25, 1974**

[54] BISTABLE MAGNETIC DEVICE	3,317,742	5/1967	Guerth.....	340/174 PM
[75] Inventor: John Richard Wiegand , Valley Stream, Long Island, N.Y.	3,370,979	2/1968	Schmeckenbecher.....	340/174 ZB
	3,451,793	6/1969	Matsushita.....	340/174 ZB
	3,757,754	9/1973	Wiegand.....	123/148 E

[73] Assignees: **Milton Vlinsky**, Plainfield, N.J.;
John R. Wiegand, Valley Stream, N.Y. ; part interest to each

Primary Examiner—James W. Moffitt
Attorney, Agent, or Firm—Ryder, McAulay, Fields, Fisher & Goldstein

[22] Filed: **Apr. 25, 1972**
[21] Appl. No.: **247,356**

Related U.S. Application Data

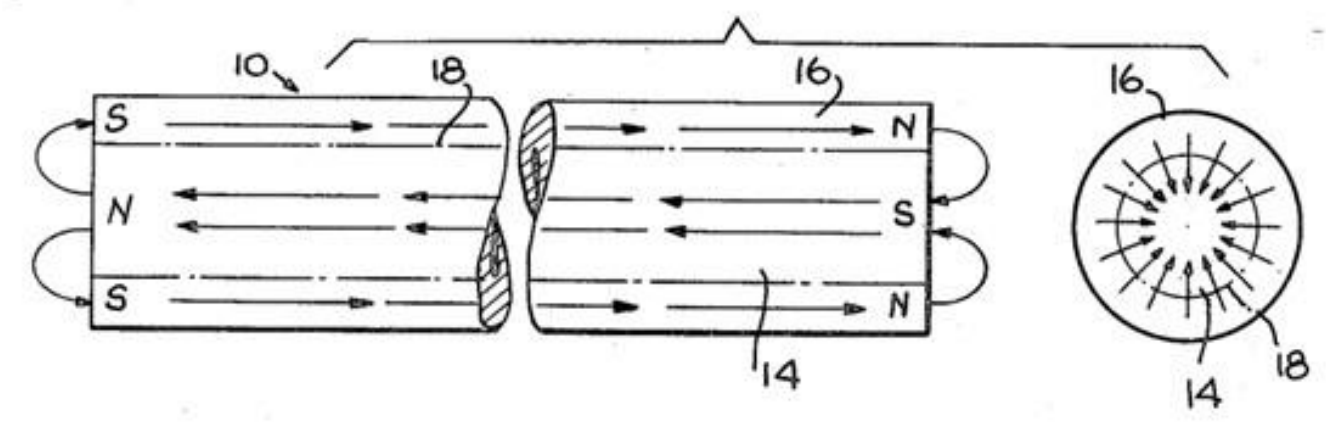
[63] Continuation-in-part of Ser. No. 5,631, Jan. 26, 1970, Pat. No. 3,602,906, and a continuation-in-part of Ser. No. 5,632, Jan. 26, 1970, abandoned, and a continuation-in-part of Ser. No. 86,169, Nov. 2, 1970, abandoned, and a continuation-in-part of Ser. No. 137,567, April 26, 1971, abandoned, and a continuation-in-part of Ser. No. 173,070, Aug. 19, 1971, abandoned.

[52] **U.S. Cl.**... 340/174 ZB, 340/174 PM, 340/174 VC
[51] **Int. Cl.**..... G11c 11/06
[58] **Field of Search.** 340/174 PM, 174 VC, 174 ZB

[56] **References Cited**
UNITED STATES PATENTS
3,134,096 5/1964 Bartkus et al..... 340/174 PM

[57] **ABSTRACT**
A bistable ferromagnetic wire of generally uniform composition having a central relatively "soft" core portion and an outer relatively "hard" magnetized shell portion with relatively low and high coercivity respectively and whereby (a) the magnetized shell portion is operable for magnetizing the core portion in a first direction, (b) the magnetization of the core portion is reversible by application of a separate magnetic field and (c) the shell portion is operable to remagnetize the core portion in the first direction upon removal of the separate magnetic field.

32 Claims, 13 Drawing Figures



MAGNETIC SENSORS

Available in 1970

■ INDUCTIVE SYSTEMS



Induction Coils (Michael Faraday-1831)

■ SEMICONDUCTOR SYSTEMS



Hall-Effect (Edwin Hall-1879)

■ MECHANICAL SYSTEMS



Reed-Relay (Valentin Kovalenkov-1922)

■ QUASI MECHANICAL SYSTEMS



Pulse-Wire (Sixtus & Tonks-1930)

Invented in 1974

■ QUASI MECHANICAL SYSTEMS



Wiegand-Wire (John R. Wiegand-1973)

INTENDED APPLICATIONS

- Contactless switch
- AC-current detection
- Motion detection
- Encoders
- Security card

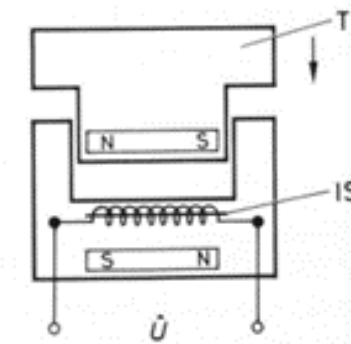


Bild 16. Kontaktfreie Taste. T Taste, IS Impulsdraht mit Spule

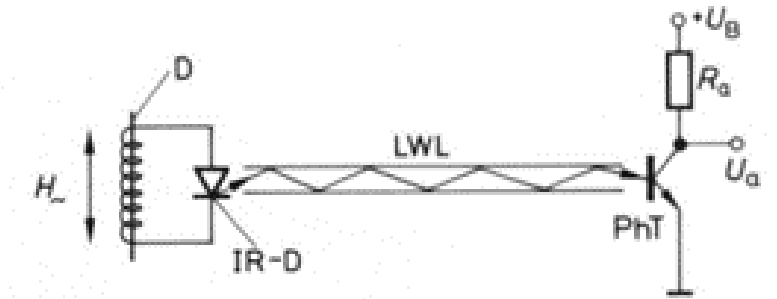


Bild 18. Signalübertragung mit Lichtwellenleiter. D Impulsdraht, IR-D Infrarotdiode, LWL Lichtwellenleiter, PhT Phototransistor

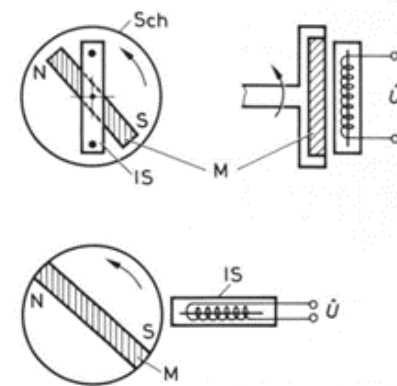


Bild 15. Zwei Drehzahlgeber mit einem Ansteuerermagneten. Sch rotierende Scheibe, M Stabmagnet, IS Impulsdrahtsensor



Bild 16. Impulsgeber für Zündelektronik.

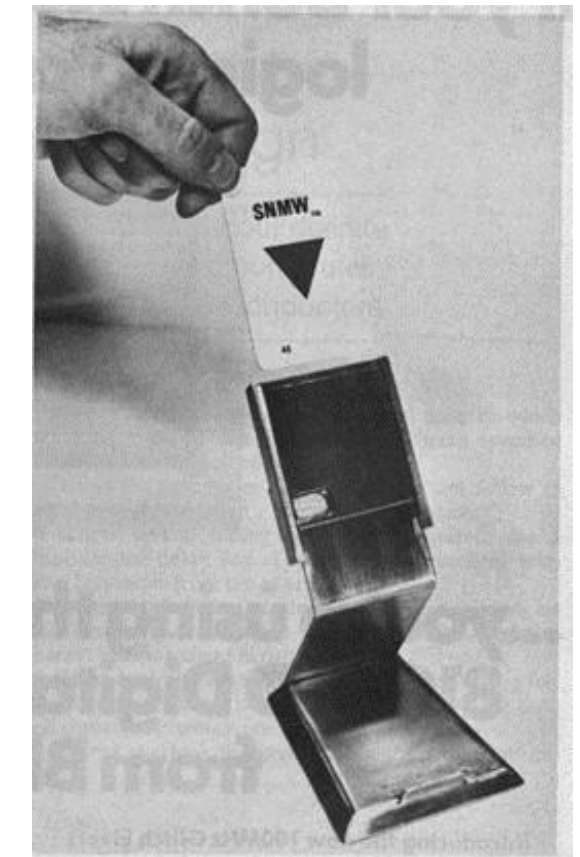


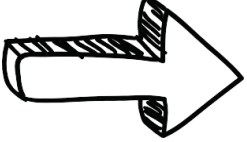
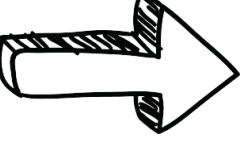
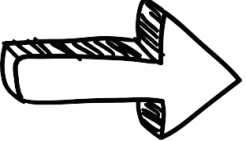
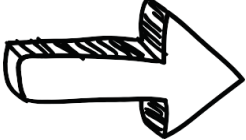
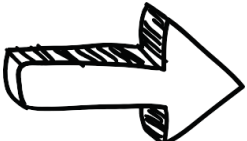
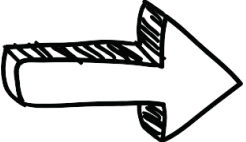
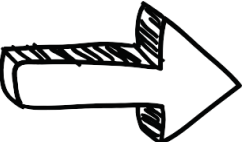
Bild 17. Kennkarte, mit zwei Reihen aus Wiegand-Drähten codiert.

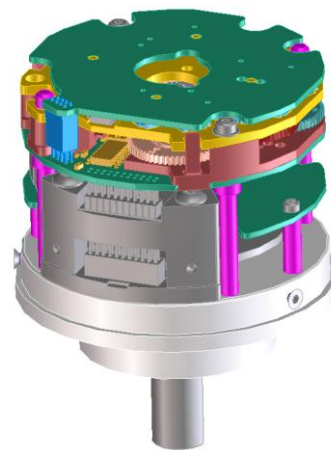
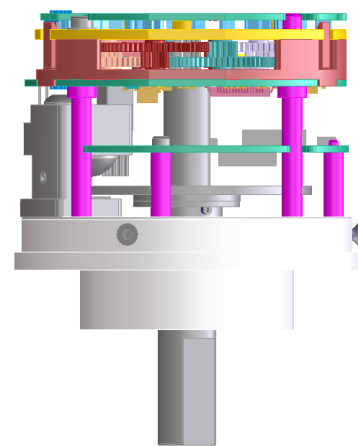


Bild 1: Modell eines elektronischen Tachogegers mit Lichtwellenleiter zur Signalübertragung – rechts das Antriebsritzel, links die (hier offene) Aufnahmeseite. Entwicklung der Fa. Günther GmbH, Nürnberg (Bilder: Vacuumschmelze GmbH)

Primary sources:
 Siemens Forsch.- und Entwickl.-Ber. Bd 15(1986) Nr.3
 Das Elektron 1980
 Elektronik Journal 10/1991
 Electronics July 10, 1975

ESG - (Environmental, Social and Governance)

- Reduce size  **Only few components, No gears**
- Avoid the use of hazardous materials  **No battery**
- Avoid the use of materials from sources with inhuman conditions  **No battery**
- Assure a safe disposition after the lifetime  **No battery, Less plastics**
- Reduce the consume of energy  **Low power electronic, Low inertial mass**
- Assure a long lifetime  **No gear, No battery**
- No service during lifetime  **No battery, Few components, Simple construction**



ENERGY HARVESTING WITH WIEGAND-WIRE

Fact: –Multiturn encoders are only possible with **gear or counting!**

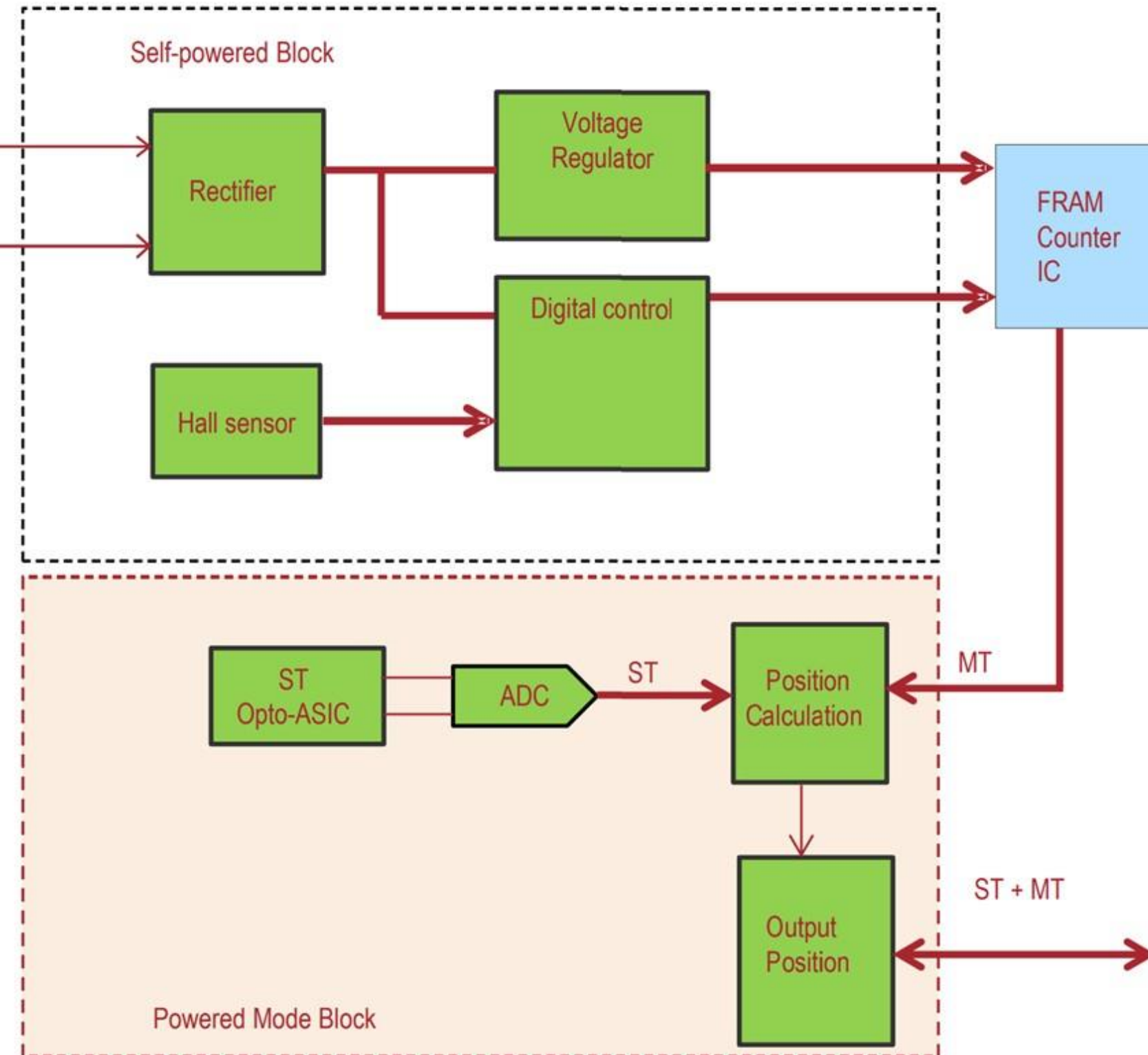
Requirements: –lower size and higher count
–higher moving speed
–no service over life time
–long lifecycle
–low cost

SELF POWERED COUNTER FOR ENCODER APPLICATIONS

ENCODER WITH WIEGAND-WIRE

Self powered counter for encoders
eg: combination with an optical singleturn

Wiegand Sensor



Basic IP's:

EP 1 565 755 B1

EP 2 515 084 B1

PRODUCTS

YESTERDAY-TODAY-TOMORROW

In 2016 Broadcom Inc./Avago Technologies acquired all the patents related to encoders with Wiegand-technology from me and my partner and are now the owner of the IP's and the know-how. In addition to developing their own chip and wire, Broadcom also manufactures encoders. The same technology is used by ELTRA/Italy and Nemicon/Japan which are 100% subsidiaries of Broadcom.



**OLD
GENERATION**



**CURRENT
GENERATION**



**NEXT
GENERATION**

CONCLUSION

The shown development of the Wiegand-wire and his applications today are a good example of how important it is that a new idea comes to the right time. The invention of John R. Wiegand was definitely very important in 1974 but the time of the Wiegand-wire for industrial applications has come only now, 50 Years after the filing of the patent.

It needed our new ideas combined with proceedings in chip technology with very low power logic, memories with very fast (less than 1us) and highest number (greater than 10^{13}) of write cycles together with new requirements of the industry in regards to higher speed, smaller size, reduced costs and last not least combined with the every day more important “green” aspect of environmental friendly constructions and avoiding hazardous materials which brought the mostly forgotten Wiegand-technology back to a new life just in time before the knowledge was lost forever.

Today a lot of different companies, many of them were our licensees and are now licensees of Broadcom, deliver to the encoder market systems based on the described Wiegand technology and this evolution is not at the end yet.



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