Metal Detectors & Accessories

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Metal detectors coil and search head design - Patents and Utility Models

Part 1

New Device Locates Buried Metal

Above—Photo shows prospector lowering the coil along a rock face to determine the presence of precious minerals. Right—A close-up of device showing coil and battery box. Electrical disturbances are transmitted from the coil to a meter. Note extreme lightness of the complete unit.

REQUIRING no technical knowledge to operate, a new detection instrument is said to be unusually efficient in locating buried metal or virgin ore. Electrical impulses, sent through a hoop-like coil, set up disturbances on a recording meter, indicating metal's presence.

Beginning this historical review for this how metal detectors search coils and search heads designs are being developed year in, year out, I understood that it is almost impossible not only to be included all Patents and Utility Models in this abstract, but it is also almost impossible to be found everything which have ever been published in the Patent Offices in the World reach back.

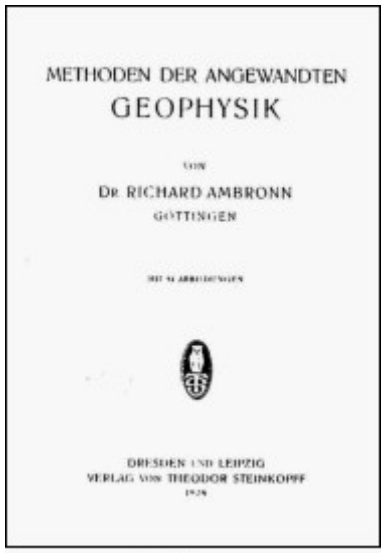
So I understood that the difficulty comes not only from the different denominations of this unalterable part of metaldetectors called in a different way by inventors and producers - "coil","head", "antenna","sensor","loop" - but from that information about their technique characteristics,

their constrction method and their design can be found in patents which are not directly and entirely purposed about searchcoils.

Accumulating enough information from issues, books, patents, a gnome of FreePatentOnline creators, confirmed my oppinion that this review should be built up only like chronology trough the years without claims to make comparative analysis. Furthermore, the patents and the utility models are not the only source of information in this field. And this gnome is:

***"Crazy Patents!** For the USPTO to issue a patent, the invention must be novel, non-obvious, and "useful." The standard for usefulness is certainly the weakest of the three -- any possible utility, no matter how small, will suffice. And, useful does not necessarily mean commercially viable. In other words, you can get a patent on some crazy things that will never make it to the shelves of your local store."*

I know that most popular in this sphere are US patents.So I supposed that it would be interesting to take a look at the archives of European Patent Offices too. That was how I ran into the first German patent of Richard Ambronn, who is founder of Applied Geophysics, published in 1930.


METHODEN DER ANGEWANDTEN
GEOPHYSIK
VON
DR. RICHARD AMBRONN
GÖTTINGEN
DRESDEN UND LEIPZIG
VERLAG VON THEODOR STEINKOPFF

Ambronn

But, as Carl Moreland mentiones in his article "Coil basics" for one of the kinds of search coils - "...Although overlap coils probably date back to the earliest experiments involving induction (1830's), and were definitely in use in the early 20th century..."

Also we should not forget that Alexander Graham Bell had been experimenting with the design of metal detector based on a device to correct the interference of induction on a telephone line.Bell began to construct a metal detector based on an induction balance invented by his friend David Hughes.

Drawings by A.G.Bell, 25 June,1881

Hughes designed and built the Induction Balance,a device whose principle led to the development of the mine detector . It was a loose connection in this device that led him to investigate what became known as radio waves. Towards the end of 1879 Hughes noticed that loose connections in his induction balance made them subject to "sudden electrical impulses, whether given out to the atmosphere through the extra current from a coil or from a frictional machine".

In 1880 he demonstrated the equipment to members of the Royal Society:

III. "On an Induction-Currents Balance, and Experimental Researches made therewith." By Professor D. E. HUGHES. Communicated by Professor HUXLEY, Sec. R.S. Received May 5, 1879.

Immediately upon the announcement of Arago's discovery of the influence of rotating plates of metal upon a magnetic needle (1824), and Faraday's important discovery of voltaic and magneto-induction (1831), it became evident that the induced currents, circulating in a metallic mass, might be so acted upon either by voltaic or induced currents as to bring some new light to bear on the molecular construction of metallic bodies.

The question was particularly studied by Babbage, Sir John Herschel, and by M. Dove* who constructed an induction balance, wherein two separate induction coils, each having its primary and secondary coils, were joined together in such a manner that the induced current in one coil was made to neutralize the induced current in the opposite coil, thus forming an induction balance, to which he gave the name of differential inductor. In those days physicists did not possess the exquisitely sensitive galvanometers and other means of research that we possess at the present day, but sufficiently important results were obtained to prove that a vast field of research would be opened if a perfect induction balance could be found, together with a means of correctly estimating the results obtained. In experimenting with the microphone I had ample occasion to appreciate the exquisite sensitiveness of the telephone to minute induced currents. This led me to study the question of induction by aid of the telephone and microphone. The results of those researches have been already published.†

Continuing this line of inquiry, I thought I might again attempt to investigate the molecular construction of metals and alloys, and with this object I have obtained, after numerous comparative failures, a perfect induction balance which is not only exquisitely sensitive and exact, but allows us to obtain direct comparative measures of the force or disturbances produced by the introduction of any metal or conductor.

The instrument which I have the honour to present to the Royal Society this evening, consists, 1st, of the new induction-currents balance; 2nd, microphone, with a clock as a source of sound; 3rd, electric sonometer, or absolute sound measurer, a late invention of my own; 4th, a receiving telephone and three elements of Daniells' battery.

* De la Rive, "Treatise on Electricity," vol. i, chap. v. London, 1853.

† "Comptes Rendus," December 30, 1878, and January 20, 1879; Society of Telegraph Engineers, March 12, 1879.

These men, although prominent in various scientific fields, did not give it much importance. George Stokes dismissed it as simply caused by induction. Hughes, somewhat disappointed, continued to experiment on the idea privately. He did not publish his research.

So, bit by bit the information increased more and more and I decided to stop here and periodically fill this review in with other published Patents and Utility Models for metal detectors search coils from my archive and may be in the future with short summaries of the novelties and of the patent claims of their creators. And why not with photos of products created under this patents and sold on the market?

The mine detector SCR-625, used by the US Army,1944

It would be pleasure for me if the people interested in this subject, independently from which part of the world they come from, having information for published but not so well-known patents and utility models, share it to enrich together this chronology.

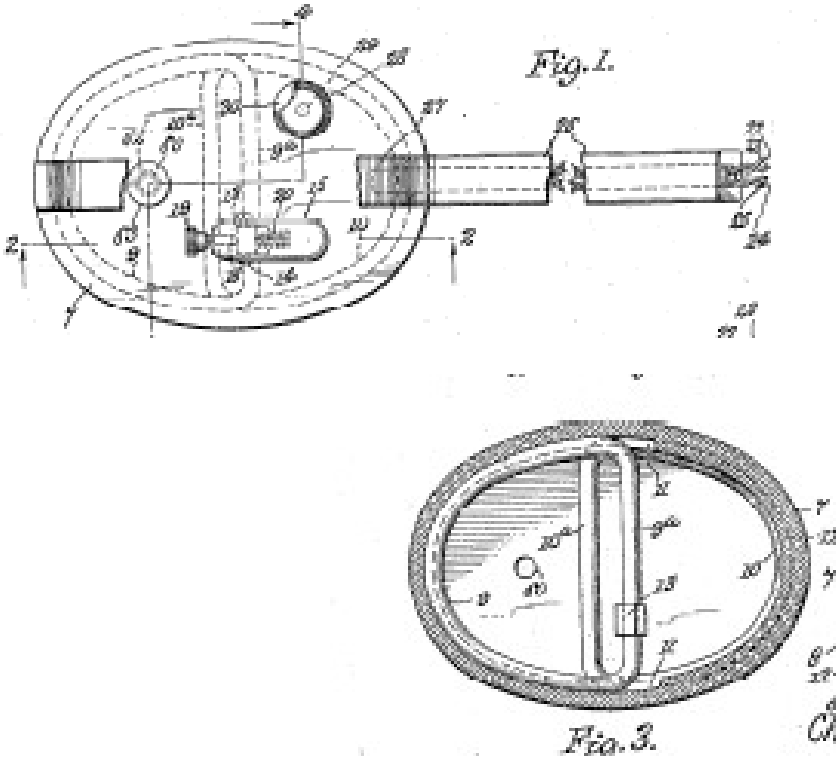
By:R.Georgieva
Version 1.0 - June,2007

- **1930 – Dr.Richard Ambronn – Patent 494831**
  Verfahren zur elektrischen Bodenerforschung mittels dem Untergrund induktiv zugeführter Wechselströme und Ausmessung des elliptisch polarisierten magnetischen Feldes durch Suchspulen.

Verfahren zur elektrischen Bodenerforschung mittels dem Untergrund induktiv zugeführter Wechselströme und Ausmessung des elliptisch polarisierten magnetischen Feldes durch Suchspulen

Open full dokument:

- **1936 - Charles Hedden - Patent US 2129058**
  Transformer for a metal locator

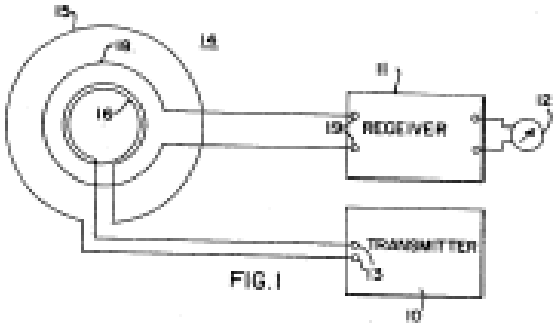


Object of the invention resides in providing an improved metal locator of an electrical nature in which the act of detection and location is controlled with great sensitivity by the use of balanced induction coils...

Open full dokument:

- **1948 – Wheeler – Patent US 2451596**

Unitary balanced inductor system



Systems of the type which has a plurality of inductors at least two of which are adapted to be connected in one electrical circuit and others in a second electrical circuit...

Open full dokument:

- **1961 – Andrew Demopoulos and George Richard -Patent US 3002262**
Method of making a metal detector search head

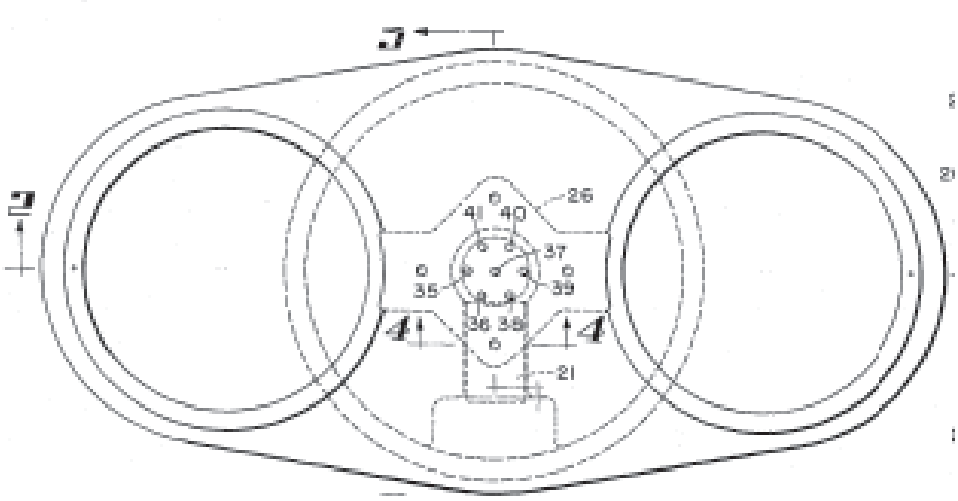


Fig 7

The present invention relates to mine detectors and particularly to a novel search head and method of manifacturing the same.A typical search head of the type under consideration comprises a "transmit" and two "receive" coils...

Open full dokument:

- **1969 - Robert Penland – Patent US 3549985**
  Metal detecting device having a disk-shaped head for housing a coil system

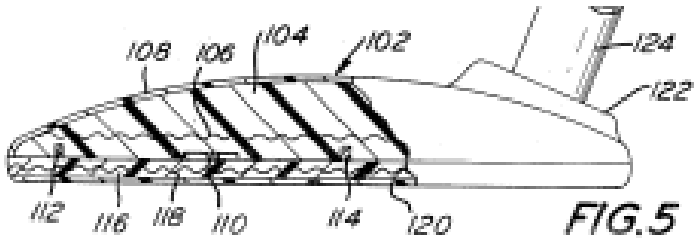
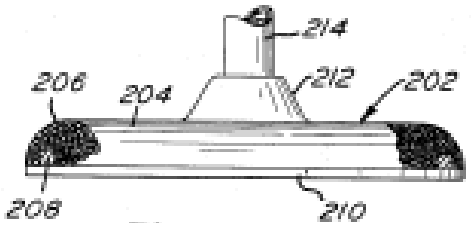


FIG.5



An electronic detector device construction which comprises a molded head for coil housing having grooves molded therein to receive electronic coils and having a hardered gel coating on the surface...

Open full dokument:

- **1972 - William Mahan - Patent US 3753185**
  Metal detecting search coil

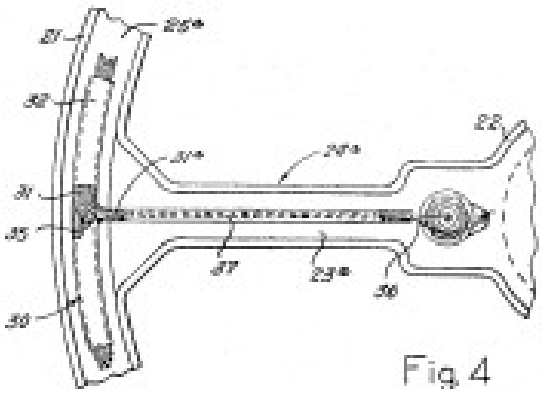
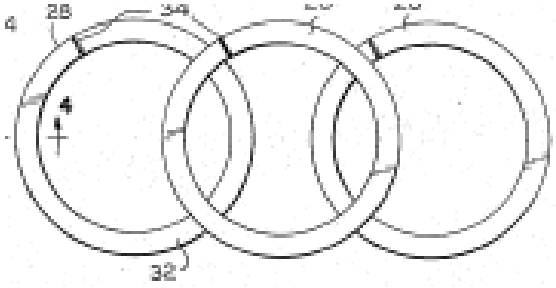


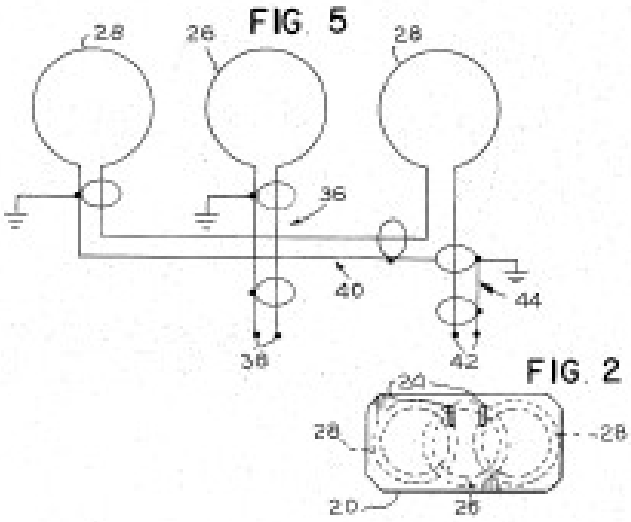
Fig. 4

The search coil is an induction coil enclosed within an annular chamber formed from a plastic housing having the form of a spoked wheel for example,and which is formed from two mating housing halves...The coil is made up of a number of turns of insulated wire wherein the insulation material...

Open full dokument:

- **1973 - Sherman Anderson – Patent US 3823365**
  Metal detecting apparatus haved improved ground-effect immunity

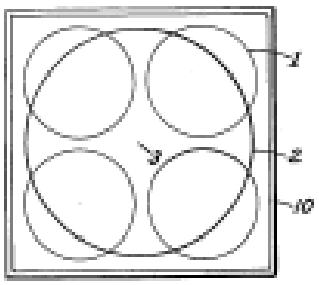


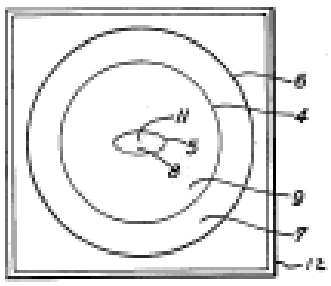


A BFO metal detector includes a support for carrying a search coil and plural compensating coils which prevent ground effects from changing the beat frequency output.The search coil forms part of a tuned circuit...

Open full dokument:

- **1974 – Alden McDaniel -Patent US 3882374**
  Transmiting-Receiving coil configuration

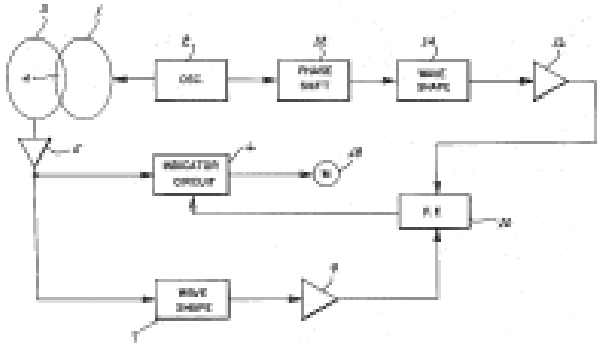


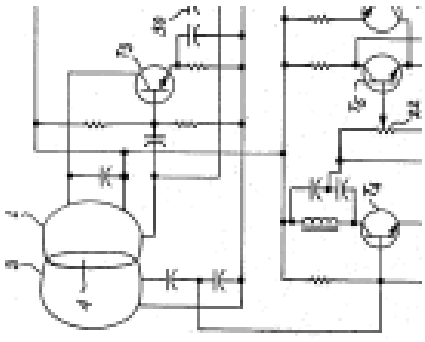


A transmitting coil is located in the same plane as two receiving coils one of which is of greater diameter than the receiving coil and the other of which is of smaller diameter...

Open full dokument:

- **1974 - Robert Gardiner – Patent US 3872380**
  Metal detector distinguishing between different metals by using a bias circuit actuated by the phase shifts by the metals

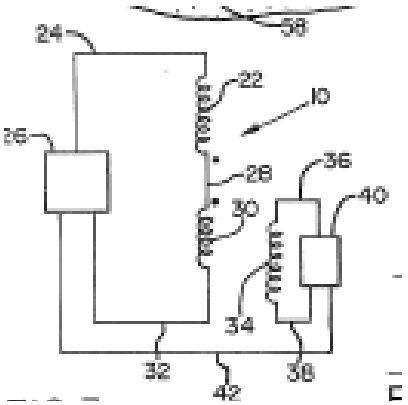




A metal detector is described utilizing a transmitting and receiving coil for detecting the presence of metal objects positioned in the field of the coils...

Open full dokument:

- **1979 – Friedrick Thompson - Patent US 4255711**
  Coil arrangement for search head of a metal detector



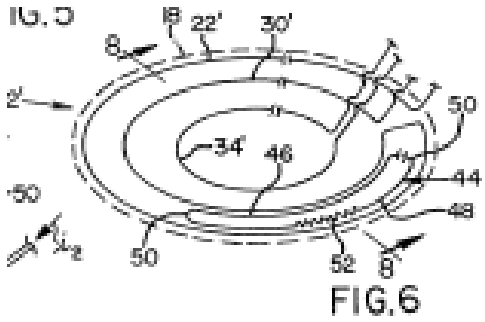
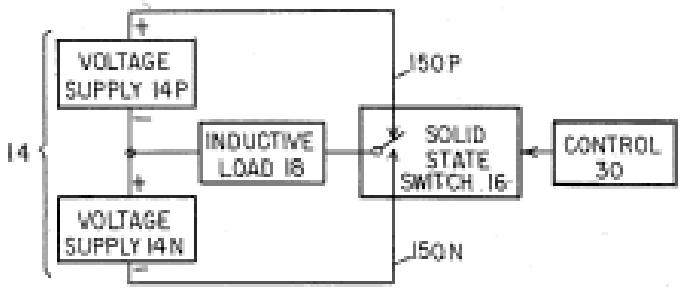


FIG.6

A unitary balanced-inductor system for use in the search head of an electronic metal detector,having a transmit coil, a smaller, preferably concentric cancel coil of opposite polarity, and a yet smaller receive coil...

Open full document:

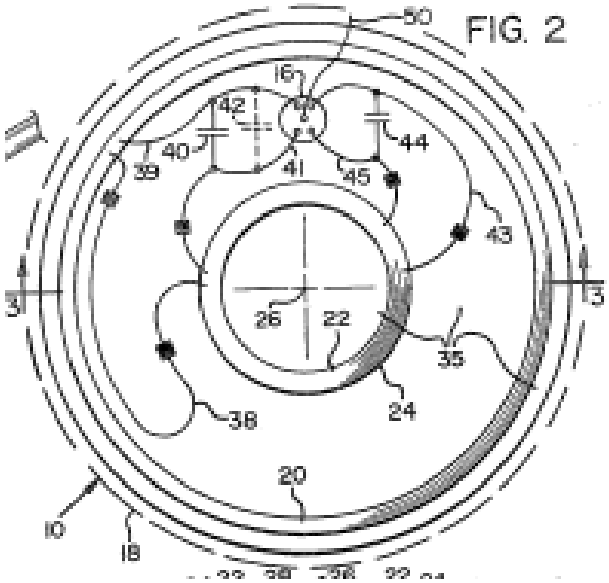
- **1979 - Carlos Riveros – Patent US 4276484**
  Method and apparatus for controlling current in inductive loads such as a large diameter coils



A method and apparatus for controlling electric current in loads that are essentially inductive...

Open full dokument:

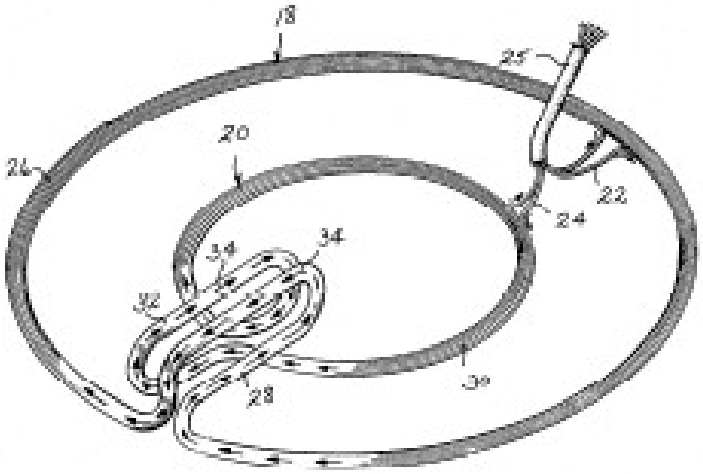
- **1979 – Douglas Johnson – White's electronics Inc.– Patent - US 4293816**
  Balanced search loop for metal detector



A search loop for a metal detector is described having a magnetic flux feedback coil whose magnetic flux opposes that of the transpit coil to provide a balanced loop...

Open full dokument:

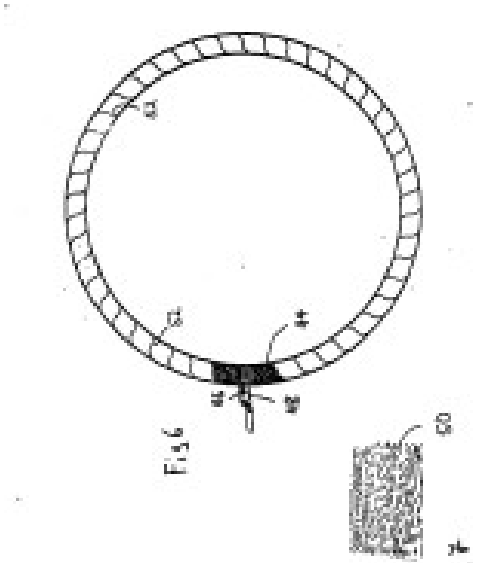
- **1980 – Paul Wilson – Patent US 4345208**
  Anti-falsing and zero nulling search head for a metal detector



A metal detector search head which includes a transmitter wire coil and a receiver wire coil each having first and second coil sections. The first coil sections of the receiver and transmitter coils lie in substantially the same plane with the second coil sections thereof being parallel

Open full dokument:

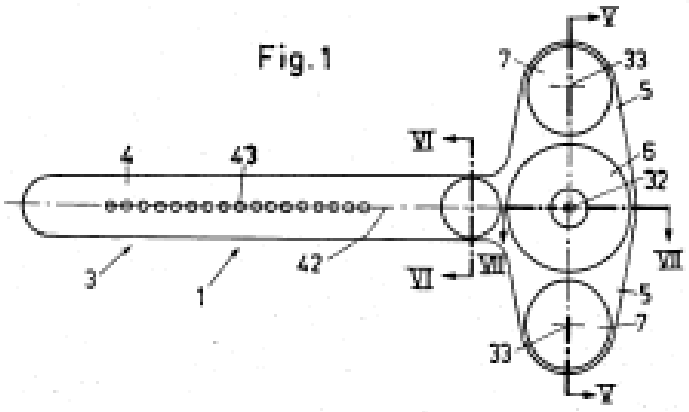
- **1984 – Klaus Ebinger – Utility Model G8336122.7**
  Suchspulenanordnung



Die Erfindung betrifft eine Suchspuleanordnung für einen Metalldetektor mit einem ringförmigen Gehäuse mit einer umlaufenden Nut zur Aufnahme der Spule, mit einem von aussen an das Gehäuse angesetzten und mit diesem verbundenen Flansch zum elektrischen und mechanischen Anschluss...

Open full dokument:

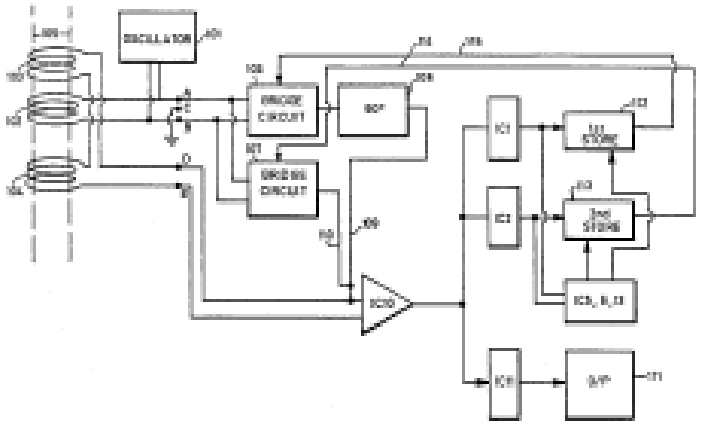
- **1985 – Andre Binard - Patent US 4552134**
  Equipment for determining the position of a metal body in a medium with low electric conductivity



The equipment comprises a support,a radiating self-induction coil mounted on the support and two receiving self-induction coils mounted on the support

Open full dokument:

- **1985 – Bruce Kerr - Patent US 4659989**
  Inductively balanced metal detector circuit with orthogonal balancing signals and including phase and polarity detection



Metal detection apparatus includes an oscillator coil driven by an oscillator , which induces in detector coils equal and opposite E.M.F.s such that a nominally zero output is produced at terminals D.E.

Open full dokument:

- **1987 – Bruce Candy - Patent US 4890064**
  Metal detector sensing head with reduced eddy current coils

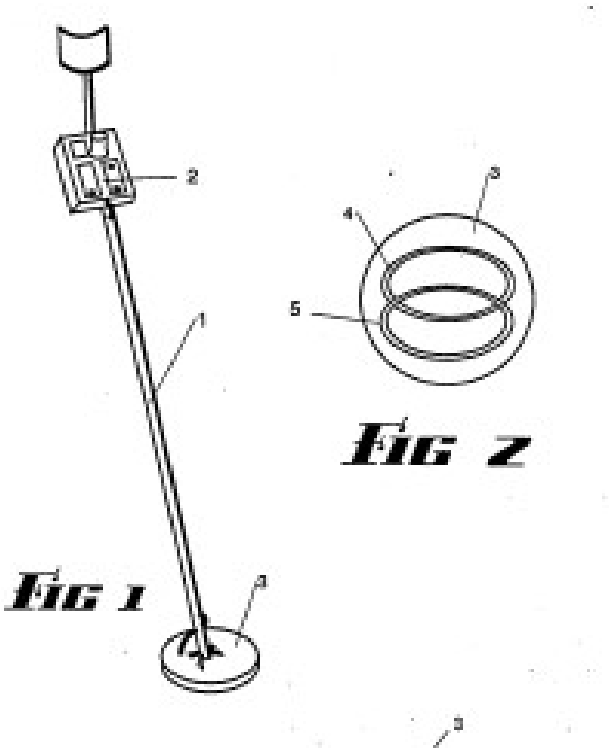


FIG 2

FIG 1

A sensing head for a metal detector including means for magnetic transmission and detection of a retransmitted signal from a target by means of at least one coil, the head being characterized in that at least some of the conductor material ...

Open full dokument:

- **1987 – Klaus Ebinger - Patent EP 0249110**
  Searchcoil for metal detector

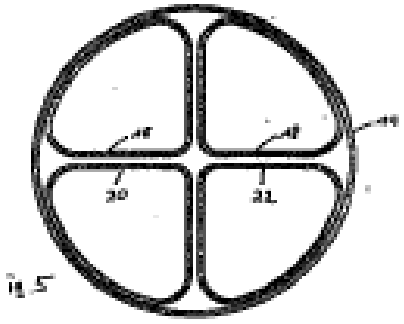
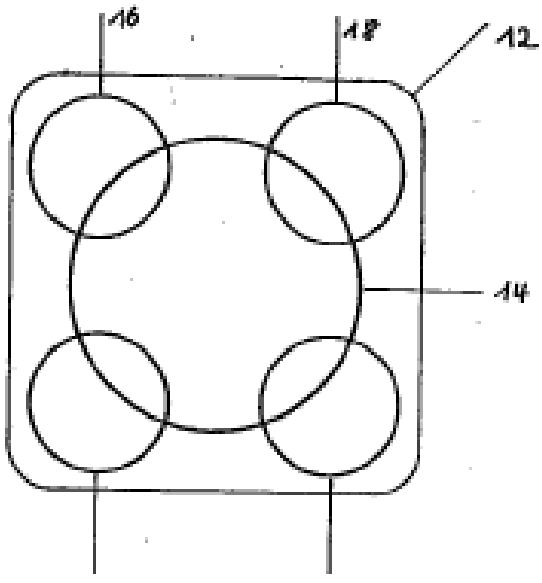
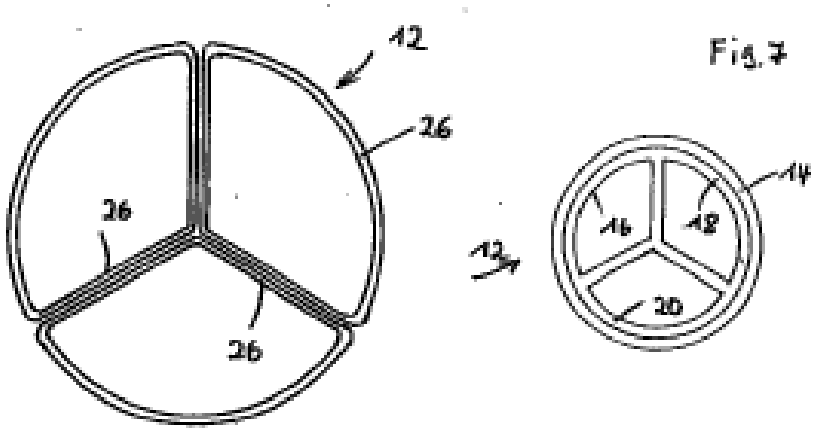
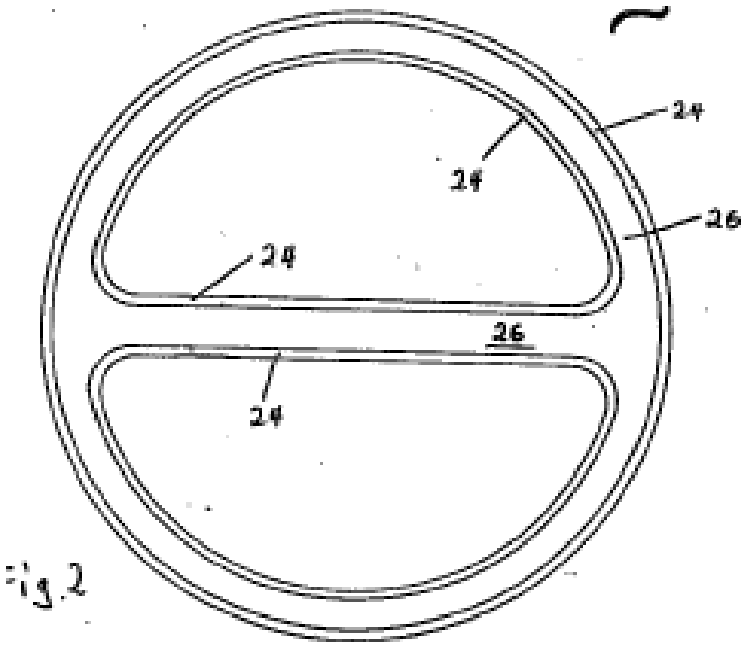


Fig 5



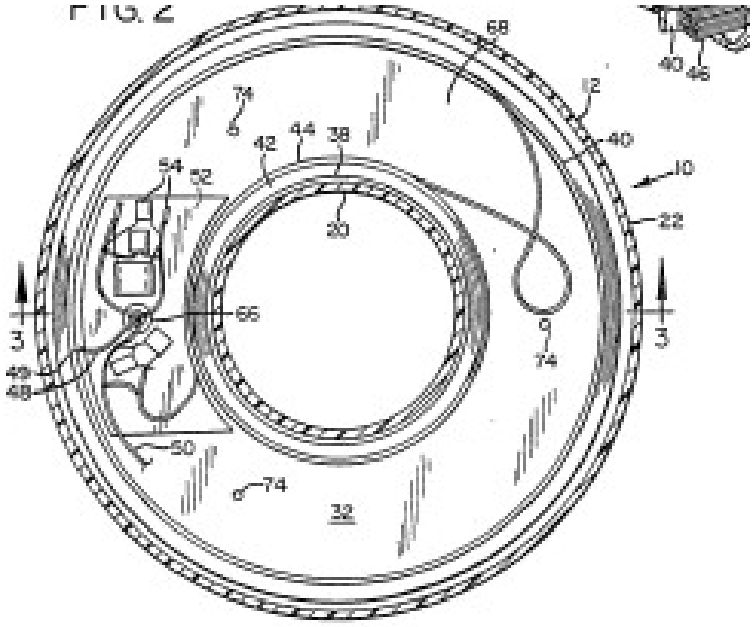




Ein als Differenzmesser arbeitendes Metallsuchgerät enthält als wesentliche Elemente einen Oszilator, eine an diesen angeschlossene Senderspule,mindestens zwei Empfängerspulen...

Open full dokument in German:

- **1988 – Inventors from White's Electronics - Patent US 4862316**
  Static charge dissipating housing for metal detector search loop assembly



A housing for the magnetic induction coils of the search loop assembly of a metal detector is constructed of plastic resin reinforced with non-metallic electrically conductive graphite fibers, and is connected to ground potential of the main electronics package of the metal detector so that the housing acts as a static-draining shield for the search loop assembly.

Open full dokument:

- **1988 – Vallon GmbH – Utility Model G8811496.1**
  Metallsuchgerät mit einer Detektorsonde

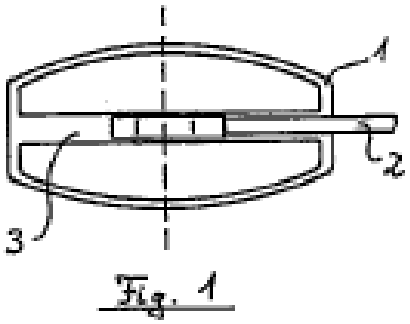


Fig. 1

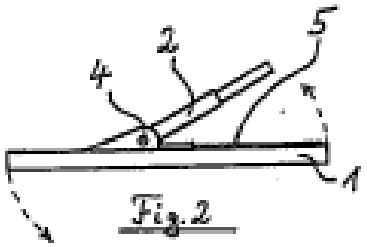
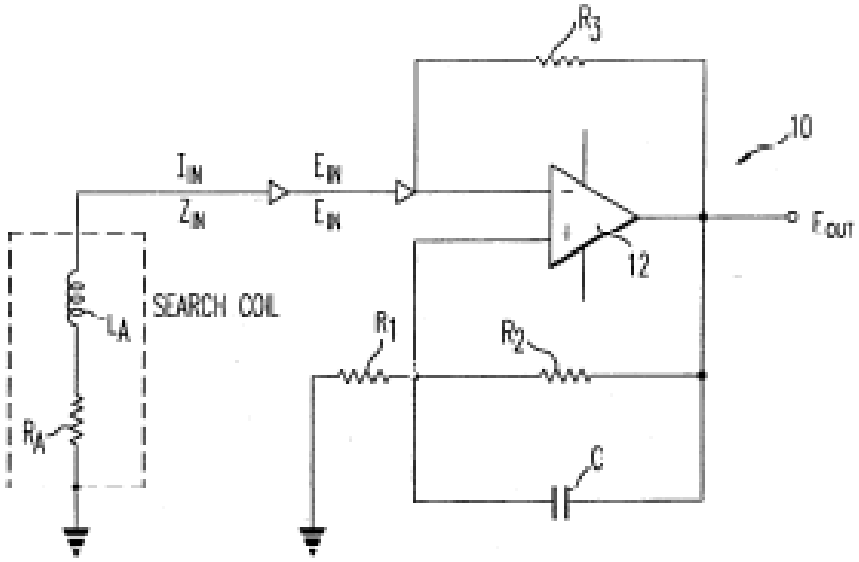


Fig. 2

Metallsuchgeräte dieser Gattung sind mit einem Stromerzeuger verbunden und erzeugen mittels ihrer im Sondengehäuse einliegenden Feld- und Empfangspulen ein elektromagnetisches Wechselfeld, wobei ein magnetisches Ortungssignal...

Open full dokument:

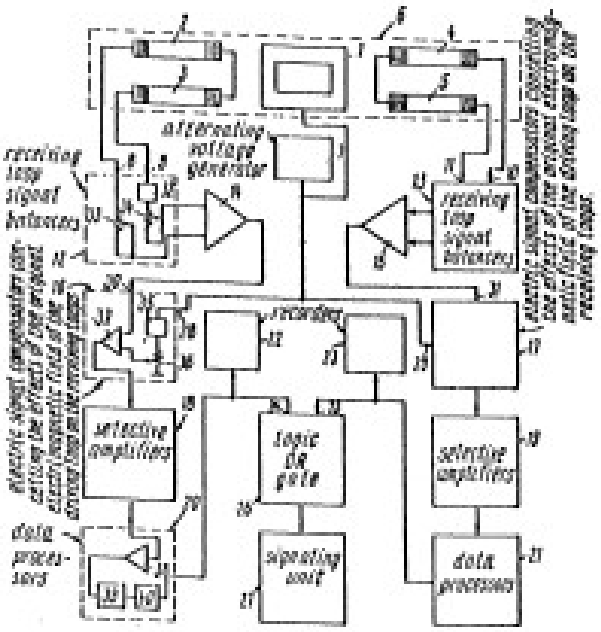
- **1990 – John Sutton - Patent US 5311198**
  Active antenna



An antenna,which may be a search coil,is connected to an operational amplifier circuit which provides negative impedances,each of which is in the order og magnitude of the positive impedances which characterize the antenna

Open full dokument:

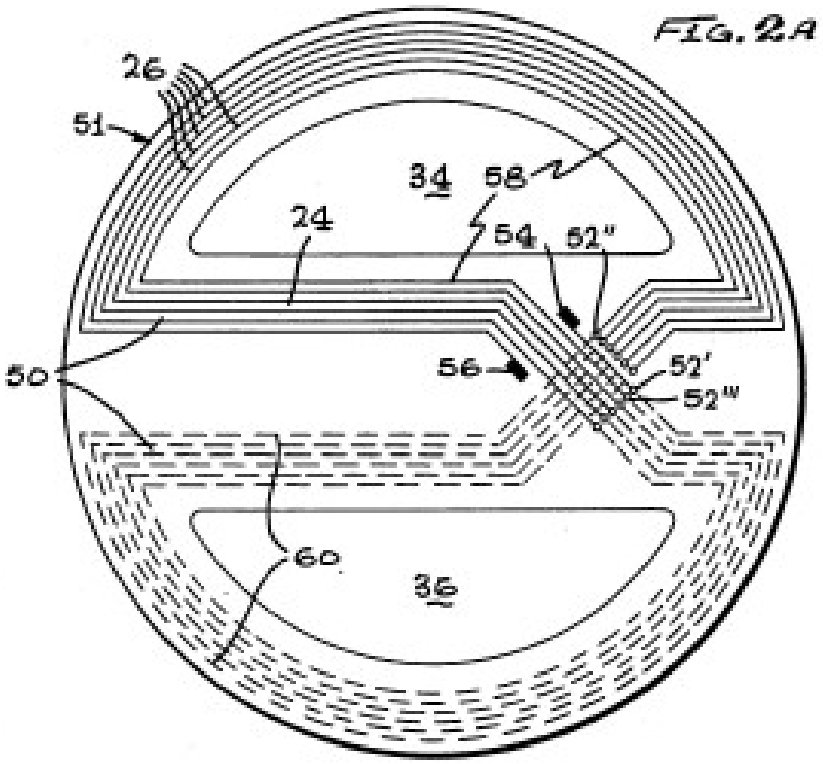
- **1990 - Inventors from Russia - US 5038106**
  Detector of metalliferous objects having two pairs of receiving loops symmetrical and orthogonal to a driving loop



The detector of metalliferous objects comptising an electrically coupled to an altenating voltage generator driving loop,rigidly fitted to two pairs of receivingloops,positioned at opposite sides of the driving loop,coaxial and parallel to one another...

Open full dokument:

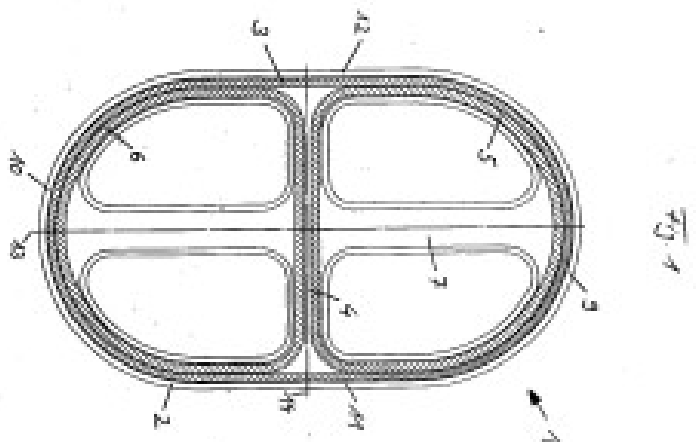
- **1992 – Institut Dr.Friedrich Forster – US 5245307**
  Search coil assembly for electrically conductive object detection



A search coil assembly for an inductive search device of the transmitter/receiver type is described having advantages relative to manufacture, repeat accuracy and sensitivity in operation...

Open full dokument:

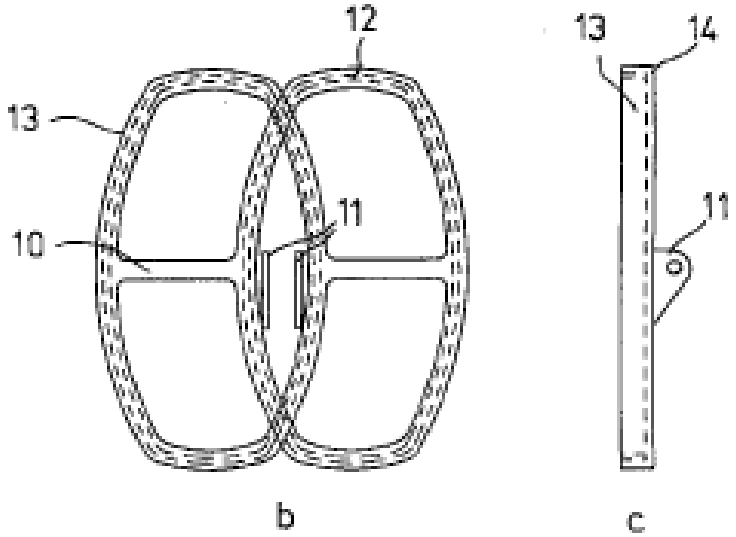
- **1993 - Klaus Ebinger – Utility Model G 9300788.4**
  Ringförmige Sonde für ein Metallsuchgerät



Ringförmige Sonde für ein Metallsuchgerät, mit einer Hauptspule und mindestens zwei Nebenspulen,mit einem Ringkörper,der die Hauptspule aufnimmt...

Open full dokument:

- **1994 – Vallon GmbH – Patent EP 0654685B1**
  Einrichtungen und Verfahren zum Erkennen von Metallgegenständen



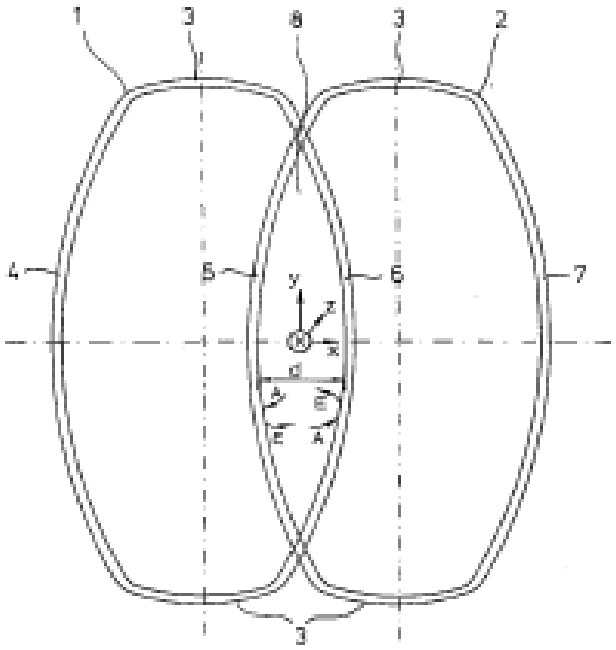
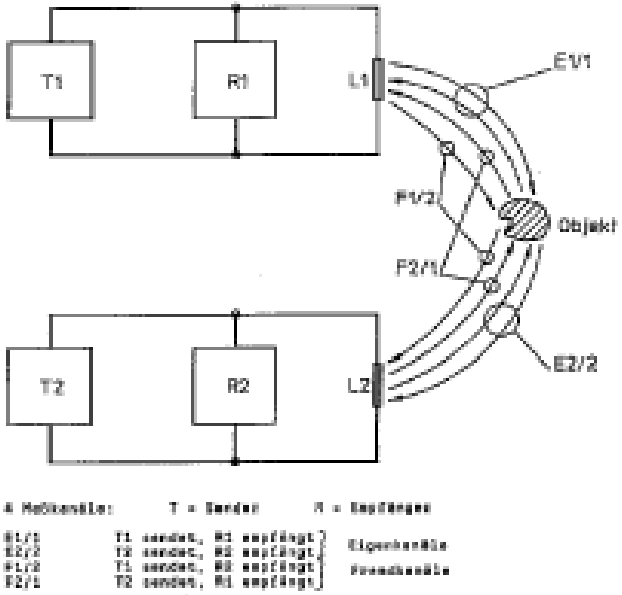


Fig. 1



Die vorliegende Erfindung betrifft einen gepulsten Metalldetektor mit einer Sonde für ein Metallsuchgerät mit mindestens einer Sende-und Empfangsspule und einer dafür geeigneten elektronischen...

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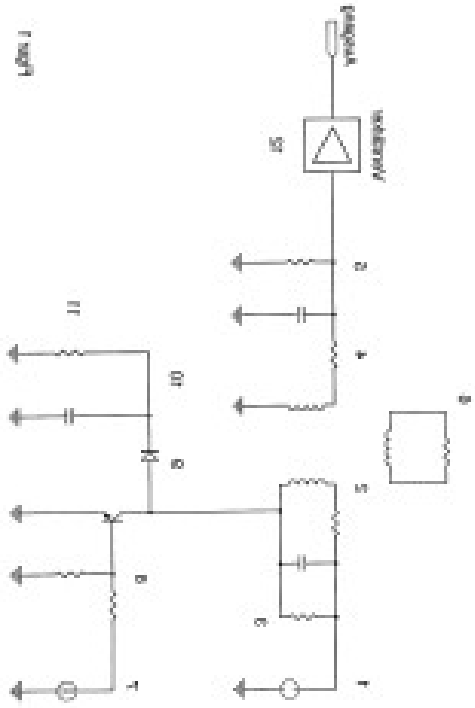
- **1995 – Institut Dr.Friedrich Forster – Patent DE 4417931**
  Schaltungasanordnung zur Wahrnehmung und Ortung von Metallgegenständen



Die Erfindung betrifft eine Schaltungsanordnung zur Wahrnehmung und Ortung von Metallgegenständen, die sich in grösserer Tiefe unter dem Erdboden oder an sonstigen der unmittelbaren Beobachtung unzugäanglichen Stellen befinden....

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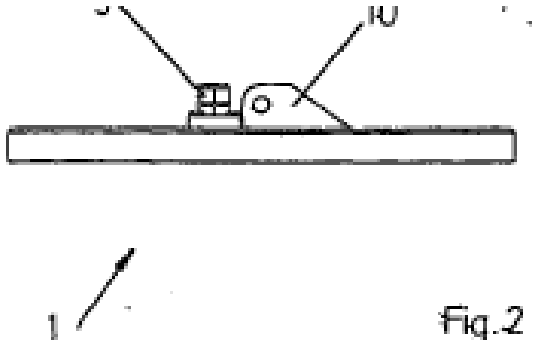
- **1996 – Klaus Ebinger -Patent EP 0764856**
  Sonde für ein Metallsuchgerät
  Sensor for a metal detector



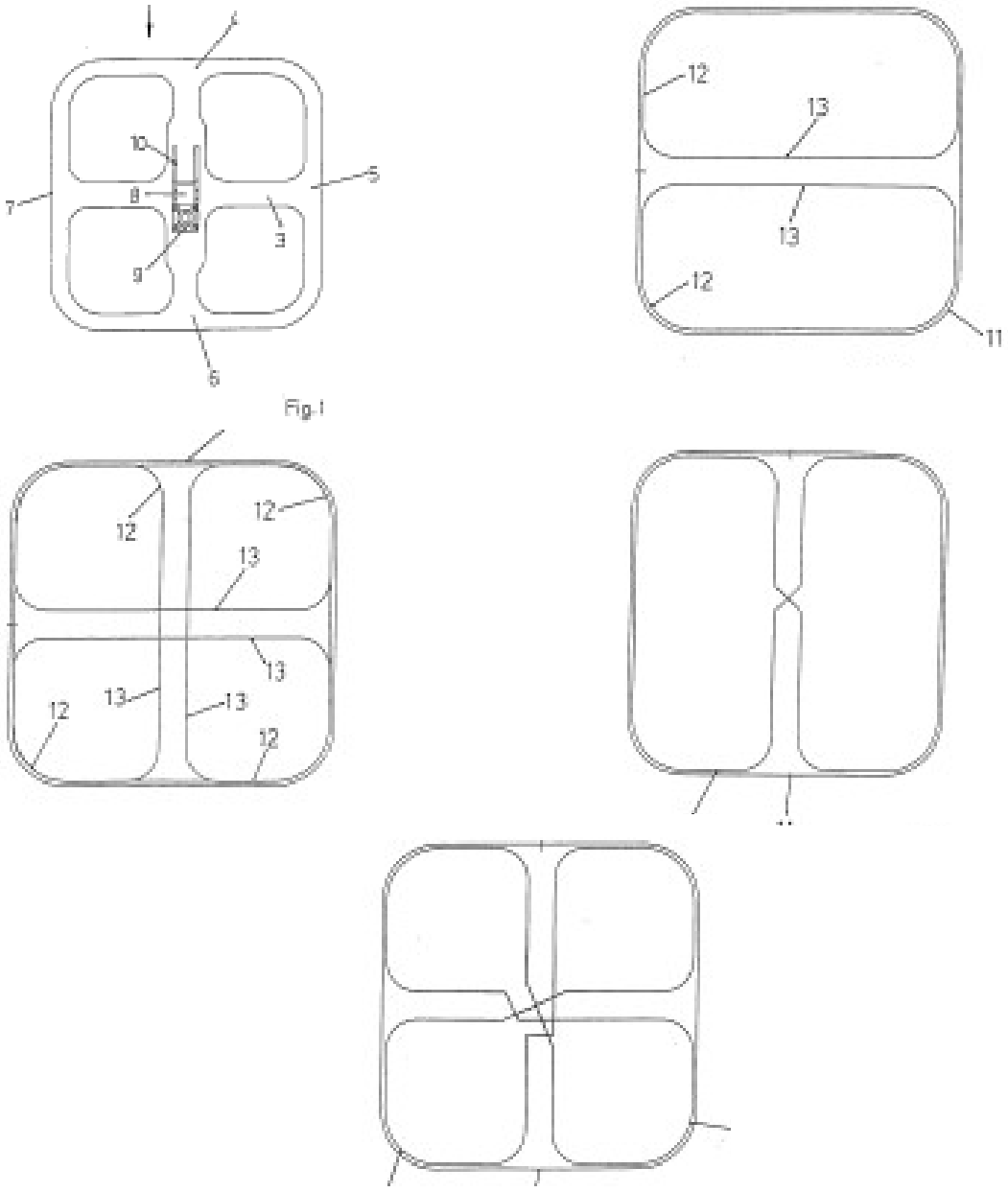


Fig.1

Die Erfindung betrifft eine Sonde für ein Metallsuchgerät mit einem ringförmigen Sondenkörper,welcher Verbindunsstege längs seiner Mittel- undQuerachse aufweist und...

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- **1996 – Institut Dr.Friedrich Forster – DE 4423661 A1**
  Suchspulenanordnung

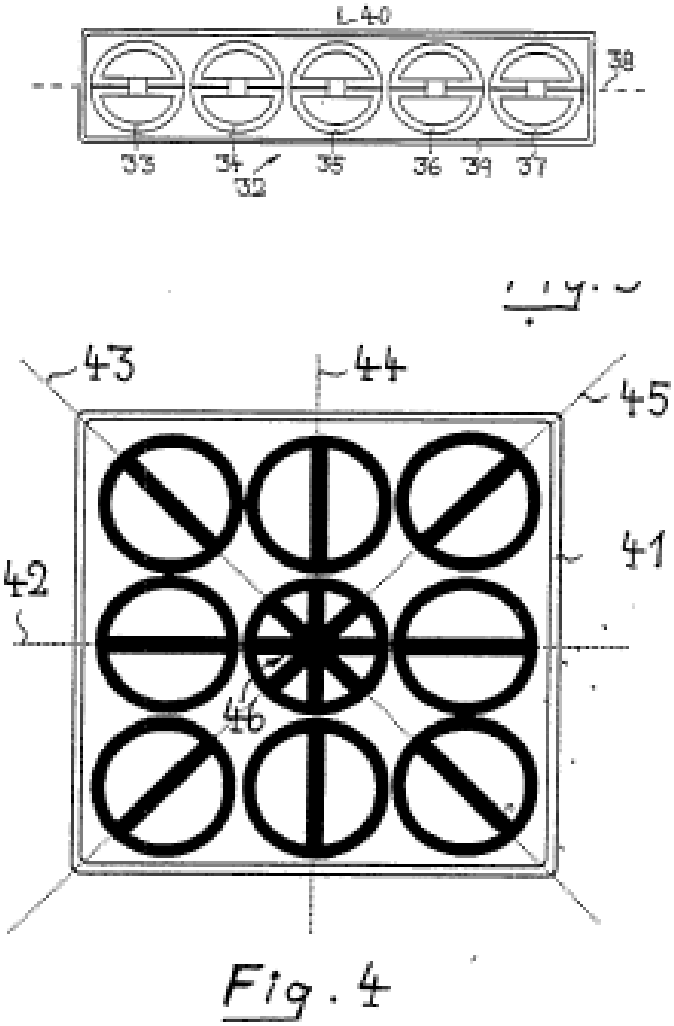

Fig. 4

Bei einer Suchspulen Anordnung für ein inductives Suchgerät mit mindestens einer,erfordenlichenfalls mit mehreren zu lateral ausgehenden Feldern kombinierbaren Sendespulen zur Erzeugung eines veränderlichen Magnetfeldes...

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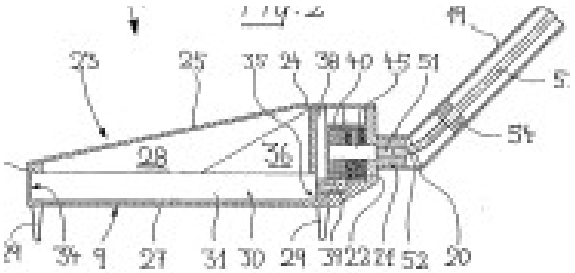
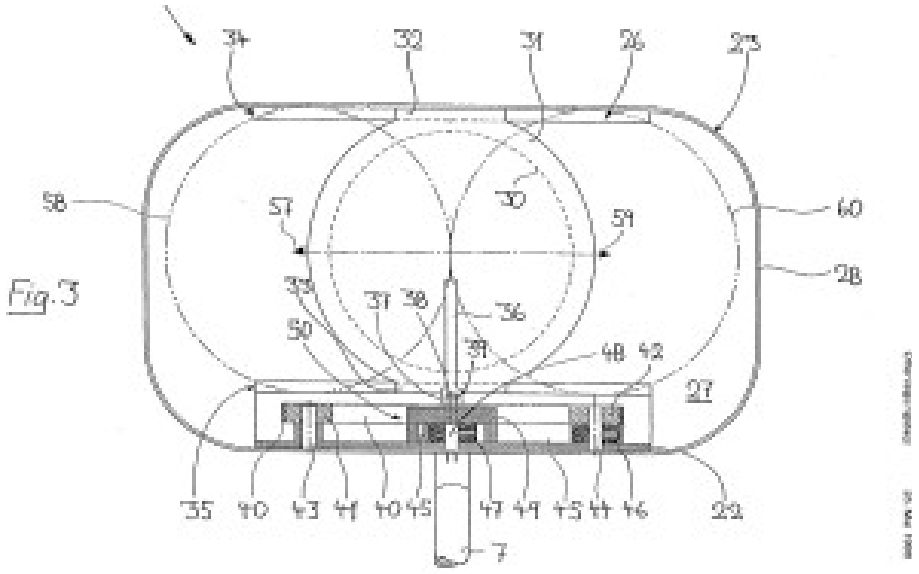
- **1998 – Institut Dr.Friedrich Forster – DE 19648833A1**
  Verfahren und Vorrichtung zur Lokalisierung und Identifizierung von im Boden versteckten Suchobjekten, insbesondere Plastikminen





Die Erfindung betrifft ein Verfahren und eine Vorrichtung zur Lokalisierung u.Identifizierung von nahe einer Bodenoberfläche im Boden versteckten Suchobjekten,die mindestens ein Teil aus einem elektrisch leitfähigen Material,insbesondere aus Metall...

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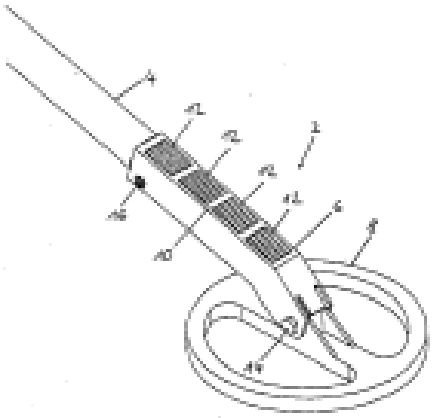
- **1999 – Klaus Ebinger – Utility Model DE 29901297**
  Metalldetektor mit Suchkopf

Metalldetektor mit Suchkopf dadurch gekennzeichnet,dass im Suchkopf mindestens ein Umwandlungselement zur Umwandlung von Sonenenergie in elektrische Energie vorgesehen ist...



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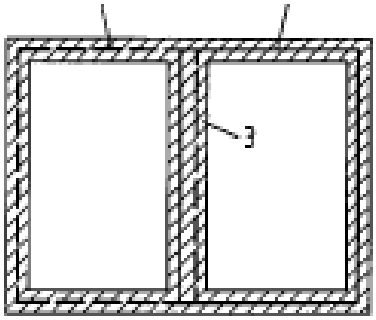
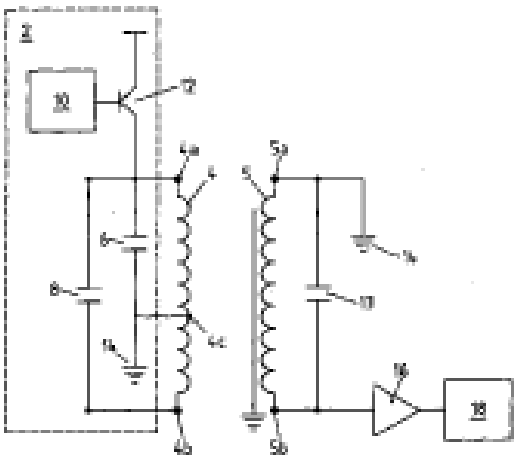
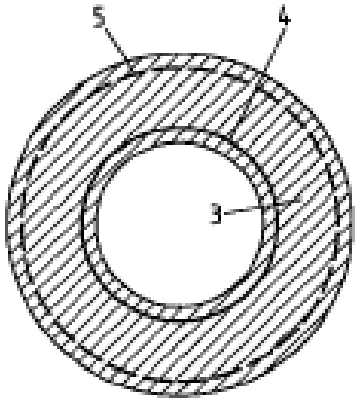
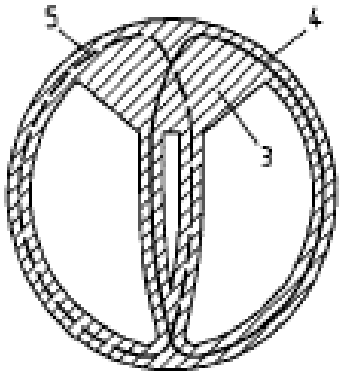
- **2002 – Mustafa Uzman - Patent DE 10157770 C1**
  Metallsuchgerät









Die Erfindung betrifft ein Metallsuchgerät mit zu mindest einer Treibeschaltung,zu mindest einer zwei äussere Anschlüsse aufweisenden Sendewicklung und zumindest einer zwei äusser...

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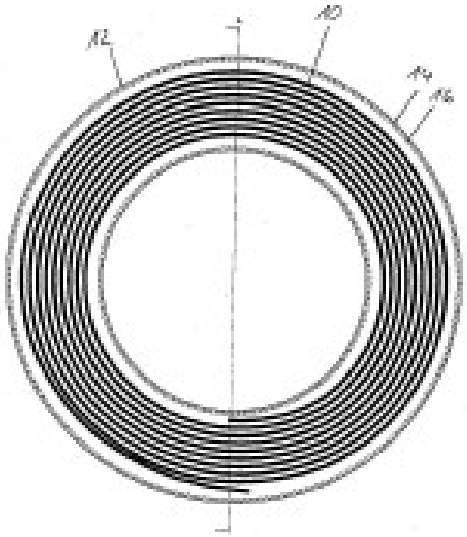
- **2002 - Klaus Ebinger – Patent DE 10037349 A1**
  Detektorspule und Verfahren zum Herstellen einer Sonde



Die Erfindung betrifft eine Detektorspule mit mehreren in einer Ebene im Wesentlichen parallel angeordneten Windungen, wobei die Windungen spiralartig angeordnet sind.Die Erfindung betrifft ferner ein Verfahren zum Herstellen einer Sonde:

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- **2004 – Carl Nelson - Patent US 7075304**
  Variable damping induction coil for metal detector

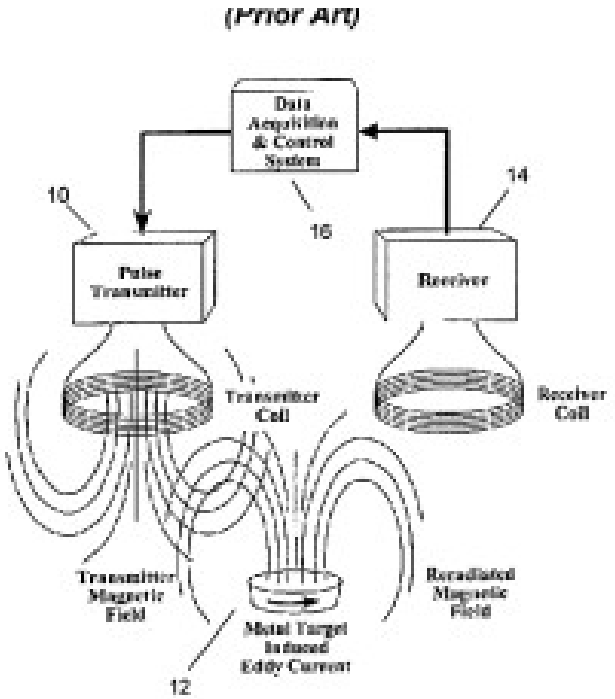
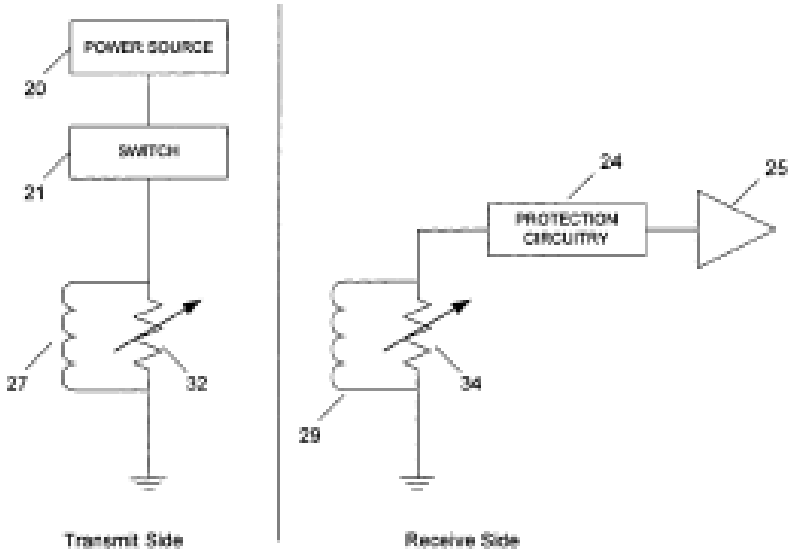


FIG. 3b



A pulse inductive metal detector that includes a variable resistor for controlling coil characteristics for both transmitter and receiver modes of operation. A coil coupled with an electronic switch is charged with current from the power source in a transmitter mode ...

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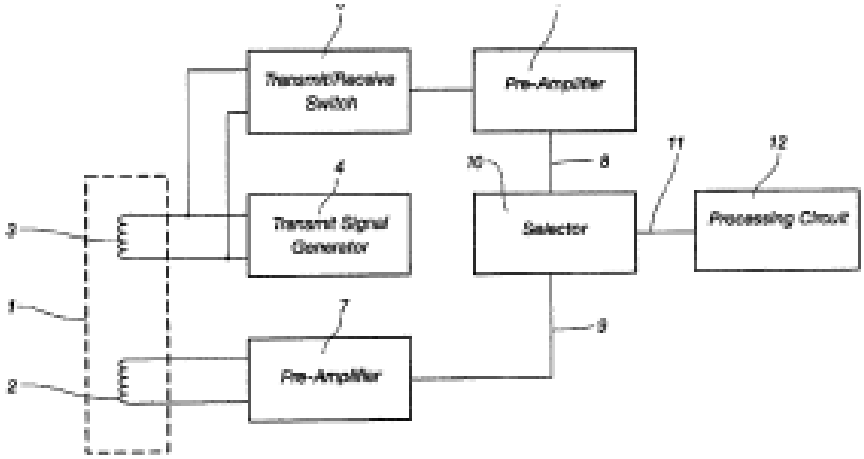
- **2004 – Bruce Candy – Patent US 6690169**

  Interference cancelling metal detector including electronic selection of effective sensing coil arrangement



Metal detection apparatus cotaining at least two inductive coils one of which acts as a transmit coil and all of which act as receive coils and processing circuity wherein a proportion of the first receive electronic signal and a proportion of the second receive electronic signal may be selected to produce various first resultant linear combination signals for the purpose of improved interference cancelling...

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References:

1. **http://www.freepatentsonline.com/**
2. **http://v3.espacenet.com/**
3. **http://dpma.de/**
4. **http://patents1.ic.gc.ca/intro-e.html**
5. **http://www.eudem.vub.ac.be/**
6. **http://www.uspto.gov/**