March 19, 1957 W. J. HERBERT ET AL 2,786,182

HIGH SPEED MAGNETIC SWITCH

Filed May 20, 1954 3 Sheets-Sheet 1

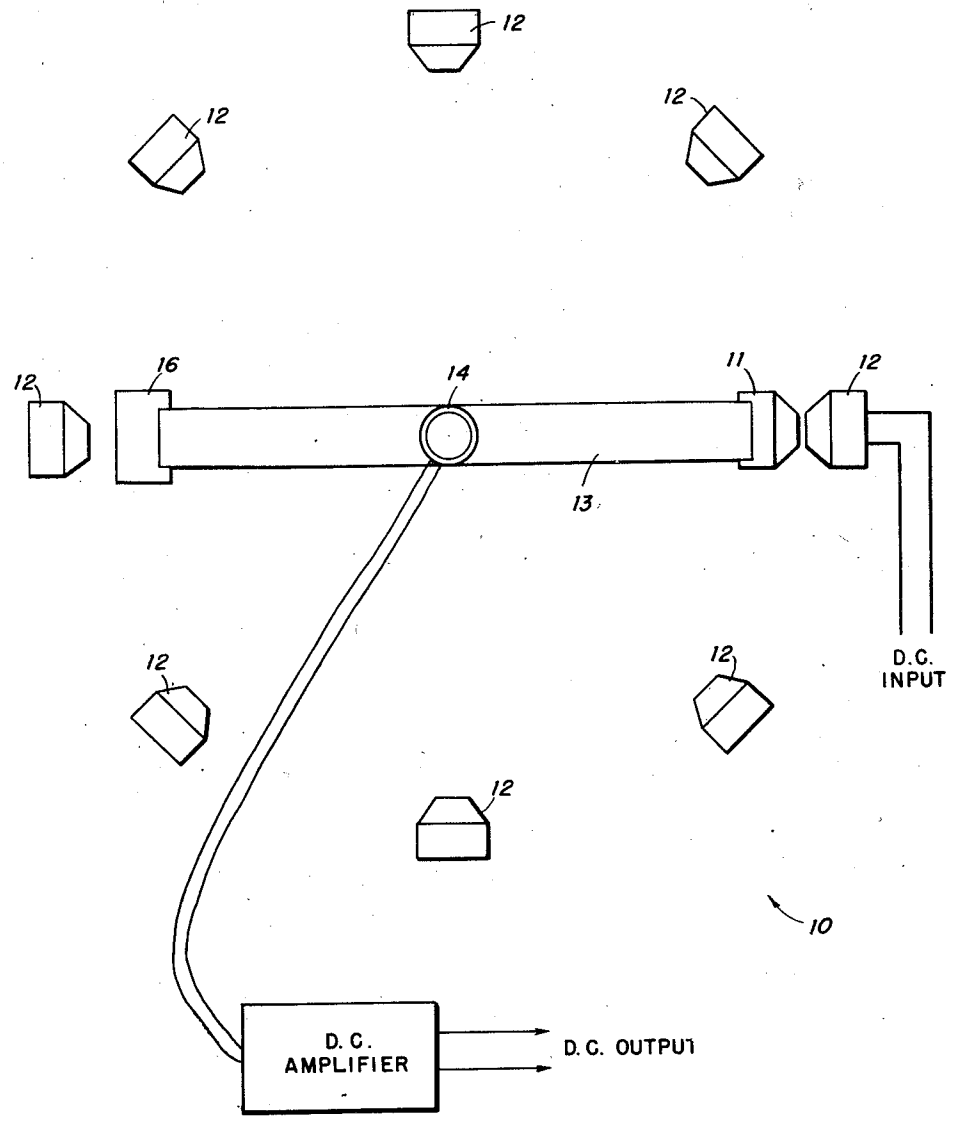


Fig. 1

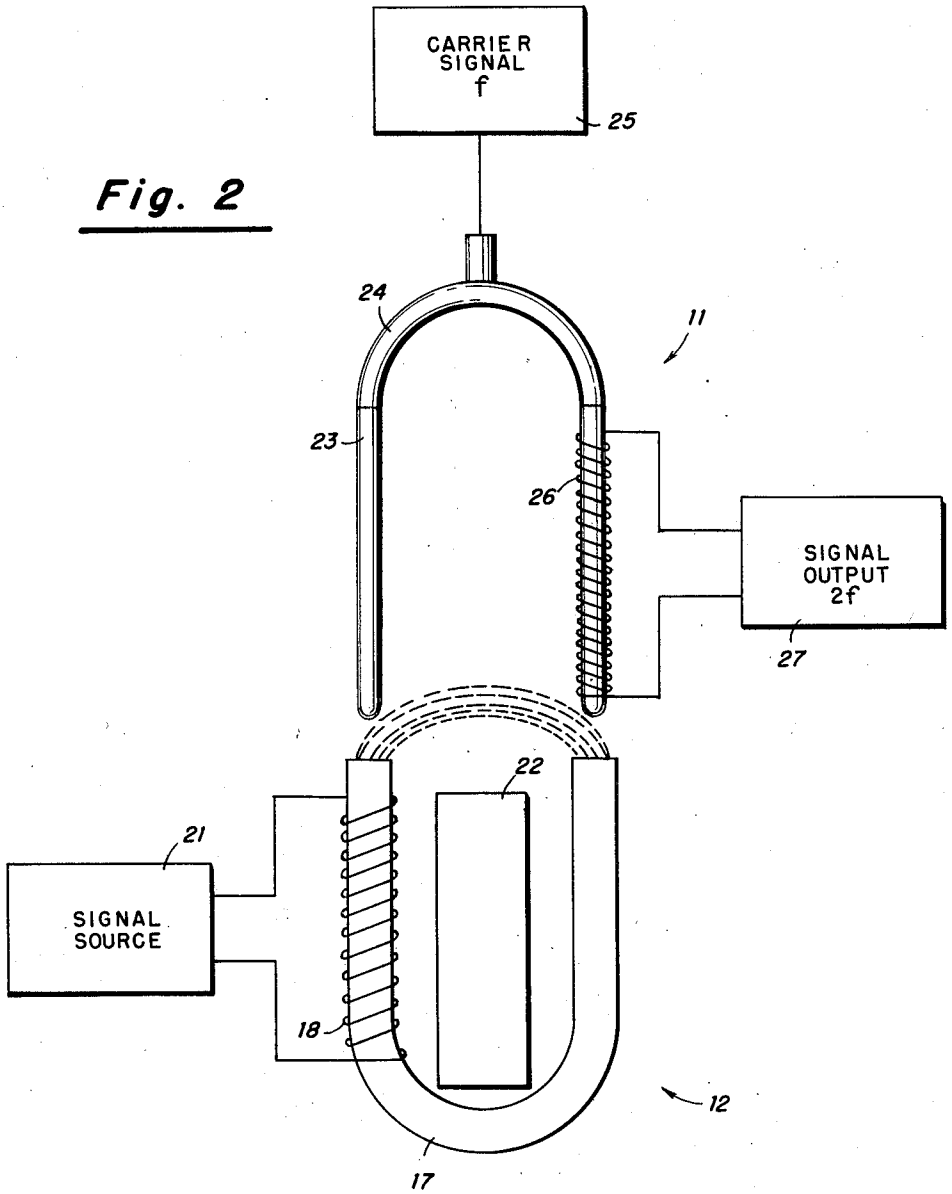
INVENTOR.
WILLIAM J. HERBERT
EVERETT E. McCOWN
BY SEYMOUR S. LEVINE
George Sipkin
George E. Pearson
ATTORNEYS

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Fig. 2



INVENTOR.
WILLIAM J. HERBERT
EVERETT E. McCOWN
BY SEYMOUR S. LEVINE
George Lipkin
George E. Pearson
ATTORNEYS

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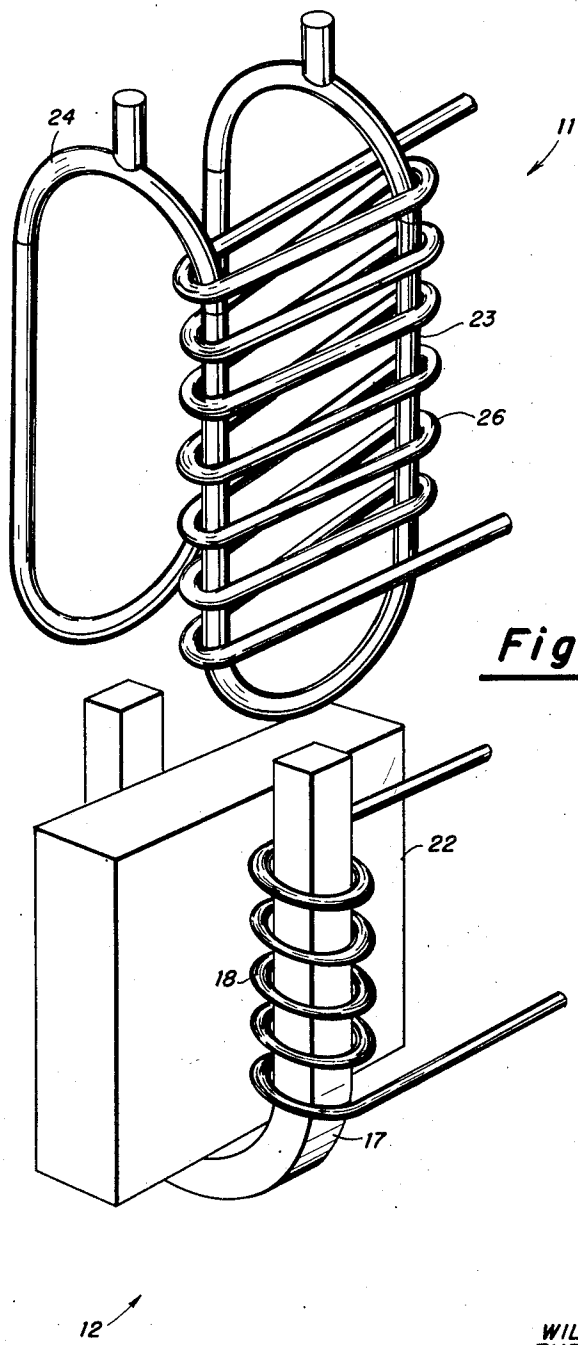


Fig. 3

INVENTOR.
WILLIAM J. HERBERT
EVERETT E. McCOWN
BY SEYMOUR S. LEVINE
George Sikkin
George E. Pearson
ATTORNEYS

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HIGH SPEED MAGNETIC SWITCH

William J. Herbert and Everett E. McCown, San Diego, Calif., and Seymour S. Levine, Hyattsville, Md.

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9 Claims. (Cl. 332—40)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a high speed rotary switch and more particularly to a rotating switch employing a flux reading pickup head and at least one magnetic head operatively associated therewith, thus providing a switching operation without mechanical wipers or contacts.

Previously known switches have employed rotating arms making mechanical contact with the stationary contacts to which signals are applied and electronic switches have also been used which sequentially open and close electrical circuits. However, mechanical contacts cause wear of the switching elements and limit the speed of rotation of the rotating switch while electronic switches are often large, complex and expensive. Both types are unable to handle low signals with accuracy.

The present invention utilizes a magnetic flux pickup head rotating in close proximity to a plurality of magnetic heads. The rotating head reads the density of flux about the stationary heads instead of the rate of change of flux and therefore does not have to be rotated at a constant speed. The switching elements do not make mechanical contact, and are very sensitive to low signals. The rotating head may be operated at high speeds and will also detect the flux density at a stationary head without rotation.

An object of the present invention is the provision of a new and improved high speed rotary switch that does not make mechanical contact.

Another object is to provide a rotating magnetic pickup switch that will detect signals independently of variable speeds and which may be rotated at high speeds.

Another object is to provide a magnetic switch employing a rotatable pickup head which will detect magnetic flux at a stationary head without being rotated with respect thereto.

A further object is the provision of a high speed magnetic switch having extremely high sensitivity for detecting magnetic flux of small density.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a symbolic view of the high speed magnetic switch with the movable flux reading head arranged for rotation in proximity to a plurality of stationary heads;

Fig. 2 is a block diagram of the reading head in close proximity to the stationary head; and

Fig. 3 shows a perspective view of the parts of Fig. 2.

Referring now to the drawings, in which like reference characters designate like or corresponding parts throughout the several views, there is shown in Fig. 1 a symbolic view of the high speed magnetic switch generally designated **10** and comprising a movable head **11** mounted for

rotation in close proximity to a plurality of stationary magnetic heads **12**. The magnetic switch **10** further comprises a motor driven arm **13** revolvable about an axis **14** equidistant from the magnetic heads **12**. At one end of arm **13** is a counterweight **16** and at the other end is the flux reading pickup head **11**. The stationary magnetic heads **12** are positioned along the circumference of the path of movement of the rotating head **11** and in close proximity thereto.

Referring now to Figs. 2 and 3, the magnetic heads **12** each consists of a highly permeable U-shaped core **17** within a coil **18** connected to a signal input source **21**. The signal input source may be a radio receiver, hydrophone, microphone or any desired signal detection device. Between the ends of core **17** is inserted a non-magnetic insulating wedge **22**, causing the magnetic flux between the core ends to curve outwardly.

The flux reading head **11**, best shown in Fig. 3, consists of two substantially parallel U-shaped cores **23** with the ends of one core connected to the corresponding ends of the other core by connecting members **24** which, in turn, are connected to a signal carrier source **25** which saturates the cores twice each cycle. The cores **23** and connecting members **24** are of such material as to conduct the carrier signal with a minimum of resistance. Around both ends of at least one core **23** is coil **26** connected to a signal output **27** to which may be attached a speaker, oscilloscope, meter, recording mechanism or other means responsive to the signal output. The coil **26** surrounds both ends of core **23** so that the electromotive force of the frequency f induced in coil **26** by the carrier signal moving downwardly through one end of the core, is counteracted and eliminated by the electromotive force induced in the coil by the carrier signal moving in the opposite direction through the other end of the core. In this manner there is no influence of frequency f or odd harmonics thereof in the signal output due to the carrier signal. The carrier current saturates core **23** twice each cycle of carrier frequency. During saturation, the reluctance of the core is such that the flux flow from core **17** of head **12** is retarded while during periods of non-saturation, the flux flow is at a maximum. In this manner the signal source, i. e., the flux flow from core **17**, is modulated with carrier signal f in the flux reading head **11** and produces in the signal output **27** a second harmonic of the carrier signal frequency.

In operation the signal input **21** produces a magnetic flux between the ends of core **17** in magnetic head **12**, the flux density being proportional to the strength of the signal input. This flux produces a magnetic field in the U-shaped cores **23**, during their periods of non-saturation, causing an induced voltage in the coil **26**. This voltage is thus proportional to the input signal and is not dependent upon the movement of the pickup head **11** over the magnetic head **12**. In this manner the switch **10** accurately transmits the input signal from each head to the signal output **27** when the switch is rotating at high speeds or at fluctuating speeds.

While one embodiment of the invention has been described, it is within the scope of this invention to utilize alternate methods of construction such as the addition of another pickup head on the other end of the arm **13**, replacing the counterweight **16**. Vertical stacking of stationary and rotor heads would further permit multiple scanning.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a high speed magnetic switch for scanning a

plurality of circuits, the combination of a rotatable arm with a magnetic flux reading pickup head on the end thereof, a plurality of U-shaped magnetic heads mounted at spaced points in close proximity to the circular path of movement of said pickup head, each of said magnetic heads setting up a magnetic flux whose density is proportional to a signal received thereby, and a carrier signal source, said flux reading head comprising a core electrically connected to said carrier signal source and a coil thereon connected to a signal output instrument.

2. In a high speed magnetic switch for scanning a plurality of circuits, the combination of a rotatable arm with a magnetic flux reading pickup head on the end thereof, a plurality of U-shaped magnetic heads mounted at spaced points in close proximity to the circular path of movement of said pickup head, each of said magnetic heads setting up a magnetic flux whose density is proportional to a signal received thereby, and a carrier signal source, said flux reading head comprising a first U-shaped core electrically connected to said carrier signal source and a coil connected to a signal output instrument, said coil being wound around both legs of said first U-shaped core in such manner that flux induced in said coil by one leg of said core opposes the flux induced in said coil by the other leg of said core thereby eliminating an induced electromotive force in the signal output due to the carrier signal in said core.

3. In a high speed magnetic switch for scanning a plurality of circuits, the combination of a rotatable arm with a magnetic flux reading pickup head on the end thereof, a plurality of U-shaped magnetic heads mounted at spaced points in close proximity to the circular path of movement of said pickup head, each of said magnetic heads setting up a magnetic flux whose density is proportional to a signal received thereby, and a carrier signal source, said flux reading head comprising a U-shaped core connected to said carrier signal source and a coil thereon connected to a signal output instrument, said core being saturated twice by said carrier signal source for each cycle of carrier signal frequency whereby the signal from said output instrument is an even harmonic of the carrier frequency and appears independently of relative motion of the pickup head and said magnetic heads.

4. In a high speed magnetic switch for scanning a plurality of circuits, the combination of a rotatable arm with a magnetic flux reading pickup head on the end thereof, a plurality of U-shaped magnetic heads mounted at spaced points in close proximity to the circular path of movement of said pickup head, each of said magnetic heads setting up a magnetic flux whose density is proportional to a signal received thereby, and a carrier signal source, said flux reading head comprising a U-shaped core connected to said carrier signal source and a coil thereon connected to a signal output instrument, said core in said flux reading head being saturated twice by said carrier signal source for each cycle of carrier signal frequency, said coil in said flux reading head having a voltage induced therein by each said magnetic head during periods of non-saturation of said core.

5. In apparatus for high speed scanning of a plurality of circuits, a carrier signal source, a rotating combination modulator and magnetic flux reading head comprising a U-shaped permeable core connected to said carrier signal source and a coil thereon connected to a signal output, a U-shaped magnetic head for each of said circuits setting up a magnetic flux whose density is proportional to an input signal received thereby, each magnetic head being mounted in close proximity to the circular path of movement of said combination modulator and flux reading head, said coil generating an induced voltage proportional to the input signal and at a frequency proportional to the frequency of said carrier signal source.

6. In apparatus for high speed scanning of a plurality of circuits, a carrier signal source, a rotating combination modulator and magnetic flux reading head comprising a U-shaped permeable core connected to said carrier signal source and saturated thereby twice for every cycle of frequency thereof, and a single coil wound in one direction on said core connected to a signal output, a U-shaped magnetic head for each of said circuits setting up a magnetic flux whose density is proportional to an input signal received thereby, each magnetic head being mounted in close proximity to the circular path of movement of said combination modulator and flux reading head, said coil generating an induced voltage during the unsaturated periods of said core proportional to the input signal and at a frequency of twice the frequency of said carrier signal source.

7. The combination as in claim 2, said pickup head having a second U-shaped core electrically connected in series with said carrier signal source and in parallel with said first core, corresponding legs of said second core being magnetically and electrically connected with said first core and in alignment therewith in the direction of rotation of said pickup head, said magnetic heads each including a U-shaped core having both poles aligned in the direction of rotation of said pickup head, the poles of said last named core being spaced equidistant with the spacing of the curved portion of said first U-shaped core from the curved portion of said second U-shaped core, said magnetic head U-shaped core completing the magnetic path with said first and second cores of said pickup head when in alignment therewith.

8. The combination as in claim 7, said magnetic heads including a non-magnetic wedge between said poles to prevent short circuiting thereacross.

9. In apparatus for high speed scanning of a plurality of circuits, a carrier signal source, a rotating combination modulator and magnetic flux reading head comprising two U-shaped permeable cores aligned in the direction of rotation of said head and electrically connected to said carrier signal source in such manner that the current moves downwardly in one leg of each core and upwardly in the other, said cores being saturated thereby twice for each cycle of frequency thereof, a coil wound in one direction about both legs of one of said cores and connected to a signal output, a magnetic head for each of said circuits positioned in close proximity to the path of rotation of said reading head, each of said magnetic heads including a U-shaped core having legs aligned in the direction of movement of said reading head, each of said magnetic heads when aligned with said reading head completing a magnetic path through which the instantaneous flux flow from said magnetic head moves in the wound core of said reading head, said carrier signal current flowing in one direction in one leg of said wound core and in the opposite direction in the other leg thereof whereby odd harmonics of said carrier signal source produce no signals in said coil, the signal output of the coil during periods of non-saturation of said wound core being proportional to the flux density of said magnetic head when in alignment with said reading head.

References Cited in the file of this patent

UNITED STATES PATENTS

2,075,380	Varian	Mar. 30, 1937
2,608,621	Peterson	Aug. 26, 1952

FOREIGN PATENTS

143,407	Austria	Nov. 11, 1935