(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 125 433**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 84103064.6

(22) Date of filing: 20.03.84

(51) Int. Cl.³: G 08 C 19/12
G 08 C 17/00

(30) Priority: 21.03.83 FI 830928

(43) Date of publication of application:
21.11.84 Bulletin 84/47

(84) Designated Contracting States:
DE FR GB SE

(71) Applicant: Valmet Oy
Punanotkonkatu 2
SF-00130 Helsinki 13(FI)

(72) Inventor: Hannukainen, Hannu
Tellervonkatu 14-16 B 1
SF-40200 Jyväskylä 20(FI)

(74) Representative: Grupe, Peter, Dipl.-Ing. et al,
Patentanwaltsbüro
Tiedtke-Bühling-Kinne-Grupe-Pellmann-Grams-Struif
Bavariaring 4
D-8000 München 2(DE)

(54) **Means for transferring pick-up data.**

(57) A means intended for use in transferring pick-up data, comprising an electrical measuring pick-up (18), such as a strain gauge assembly or a capacitor, and electric power supply means (12,20,21) by which power is supplied to the measuring circuit. The signal obtained from the measuring circuit is supplied to a voltage/frequency converter (10) to be its input signal (U_{in}). The output signal of said converter (10), the frequency (f_{out}) of which is dependent on the state of the pick-up (18), is supplied to antenna means (15). The varying frequency (f_{out}) is wirelessly received with an antenna (22) and with receiving, demodulating and detecting means (23,24). The strain gauge or strain gauge pair (Rv) is part of the bridge circuit (11), the equilibrium voltage (U_o) of which is supplied over an amplifier (13) or directly to become the input signal (U_{in}) of the voltage/frequency converter (10). For voltage/frequency converter (10) is used a micro-circuit, the central frequency (f_o) of the converter (10) being set with a capacitor (C) connected across certain terminals ((6)-(7)) of said micro-circuit.

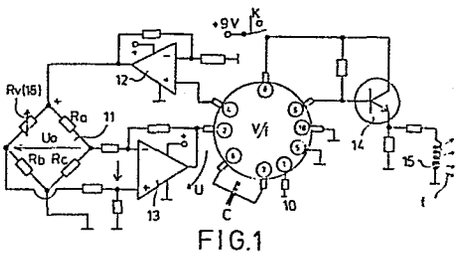

FIG.1

EP 0 125 433 A1

0125433

Means in transferring pick up data

The present invention concerns a means for transferring information from a pick-up, said means comprising an electrical measuring pick-up, such as a strain gauge assembly, a capacitor or equivalent, and electric power means by which power is supplied to the measuring circuit.

It is known in prior art to transmit pick-up information in wireless fashion. One example of a means known in the art is a means for measuring the torsion or the torque of a shaft, where a large collar is placed around the shaft. Within this collar is provided a source of d.c. electricity and a bridge circuit in which strain gauges measuring torsion or torque are incorporated as components. The equilibrium voltage of said bridge circuit is carried to a modulator which controls a 10.7 MHz transmitting device. The system furthermore comprises a fixed means external to the shaft under measurement and comprising a coil antenna, receiver/demodulator means and means for displaying or recording the measured data. The means of prior art, such as that just described, are complex in construction and therefore they cannot be used in every desired application.

One of the applications of the present invention is a wireless pick-up data transferring means, i.e., a telemetric means, by which it is possible to measure the temperatures, moments, pressures, stresses etc. present at various points for instance in a machine, such as a tractor.

The object of the present invention is to provide, for the applications discussed, a new means usable in pick-up data transfer. A particular object of the invention is to provide a means of which the space requirements are small, so that the means is also usable in those applications where the use of means of prior art has been inconvenient or outright impossible owing to their size. It is a particular object of the invention to provide a means in which the

signal/noise ratio can be made sufficiently high; where the number of components, as well as the power requirement, is small; and which has minimal temperature dependence.

In order to attain the aim presented above, and other aims which will become apparent later on, the invention is mainly characterized in

that the signal obtained from the measuring circuit is supplied to a voltage/frequency converter to be its input signal;

that the output signal of said converter, its frequency dependent on the state of the pick-up, is carried to antenna means; and

that said varying frequency is by wireless technique received with an antenna and with receiving, demodulating and detecting means.

According to the invention is obtained a simple device which tolerates stress well and requires minimal space. For central component in the pick-up data transfer means has been used a voltage-/frequency converter, e.g. one of type AD 537. Around this central component have been disposed the other requisite blocks, which in actual fact only comprise the bridge circuit with its voltage supply and the antenna coil with matching transistors.

In the following, the invention is described in detail with reference to an embodiment example of the invention, presented in the figures of the attached drawing, but to the details of which the invention is not narrowly confined.

Fig. 1 presents, in the form of a block diagram, the pick-up transmitter means of the invention.

Fig. 2 presents more closely the voltage/frequency converter unit applied in the invention.

Fig. 3 presents a mechanical application example of the means of the invention and its use in connection with a shaft constituting

the object of measurement.

The pick-up/transmitter means depicited in Fig. 1 comprises a voltage/frequency converter 10 (V/f), to the input terminal 2 of which has been connected the bridge circuit 11 containing the pick-up arrangement. The stabilized voltage supply of the bridge circuit 11 is provided through an operation amplifier 12, which buffers the existing reference voltage U_R derivable from the terminal 4 of the means 10. The branch Rb,Rv of the bridge 11 contains the pick-up resistance Rv (18) or a pair of resistances, e.g. a strain gauge, a temperature-dependent resistor, or equivalent. The error voltage U_0 reflecting the deviation of the bridge is amplified with a differential amplifier 13. The amplifier 13 may also be omitted if the unbalancing of the bridge 11 is powerful, and in that case it becones possible to control the current take-up of the converter 10 directly. The amplifiers 12,13 are for instance of type LM 258.

The power source, e.g. a miniature storage battery 20 (9 volts) is connected over the switch K and the voltage regulator 12 to the terminal 8 of the converter 10. The frequency output (8)-(9) (f_{out}) of the converter 10 has been connected over a matching transistor (e.g. 2 N 3704) to the coil 15 serving as transmitter antenna. The transistor 14 has been connected to operate as an emitter follower. The band of long-wave transmitting frequency f_{out} of the circuit of Fig. 1 is for instance between 50 and 150 kHz. The central frequency f_0 of the converter 10 is selected with the aid of a capacitor C connected across its terminals (6)-(7), and this capacitor must be of high enough quality.

As shown in Fig. 3, the measuring system includes, in addition to the pick-up/transmitter means, a receiving antenna 22, a receiver-/modulator combination 23 and an indicator, printer or other recording means, such as a tape recorder.

The operation of the means described is as follows. With the bridge circuit 11, the pick-up datum Rv is converted into a voltage signal, which is amplified and conducted to the voltage/frequency con-

verter 10, which converts the voltage signal into a radio frequency signal. It is thus understood that frequency modulation is applied. If for instance the commercially available micro-circuit AD 537 is used for converter 10, the central frequency f_o may be calculated as follows, with the notations of Fig. 2:

$$f_o = \frac{U_{in}}{10\ (R_1 + R_2)\ C} \quad .$$

The transistor 14 matches the frequency to be appropriate for the antenna 15. The antenna 15 is, as a rule, a small coil.

In Fig. 3 has been shown a mechanical embodiment example of the pick-up means of the invention. The pick-up means has been disposed, for instance, around the power transmission shaft 25 of a tractor. In this application, too, the pick-up means is required to consume little space, to draw little power and to present a good signal/noise ratio. By means of the strain gauge 18, mounted in connection of the shaft 25 in a manner known in the art, is measured for instance the torque transferred by the shaft 25, on the basis of the torsion of this shaft 25.

The pick-up/transmitter means 10-14 of the invention has been mounted on an electronic circuit board 16, and its components have been embedded in an insulating compound 17, e.g. in epoxy resin. To the circuit board 16 is carried the lead from the pick-up 18 and the lead from the miniature storage battery 20. The miniature storage battery 20 is placed, with reference to the electronic circuit board 16, on the opposite side of the shaft 25 in a holder 19, in conjunction with the latter being further provided a voltage regulator 12, from which a lead 21 departs to the circuit board 16. With a placement of components as in Fig. 3, the measuring means does not cause any harmful mechanical unbalancing of the shaft 25. The simplest way to mount the parts 17, 19 and 20 shown in Fig. 3 in conjunction with the shaft 25 is to wind these parts with tape. If the means is meant to be a permanent pick-up/transmitter means in conjunction with the shaft 25, it is possible to dispose the means in a special housing, the parts of this housing being fixed e.g. by their marginal flanges to each other and around the shaft

25. The switch K may be arranged to be remote-controlled or to operate e.g. by centrifugal force so that it will only be closed when the shaft is rotating, or when otherwise needed.

The antenna coil 15 is fixed in conjunction with the shaft 25 that is being studied. The antenna coil 15 emits into its surroundings a long-wave electromagnetic radiation, the frequency f_{out} of which is in the range from 50 to 150 kHz mentioned above. The radiation is received with the antenna 22 and with receiver/demodulator means 23 placed in the vicinity, and it is detected and if required recorded with means 24, in which the acting signal is dependent in a known manner on the resistance of the pick-up resistor R_V.

It is possible to connect a known resistance across and/or in series with the pick-up resistance R_V, and in its conjunction a switch, whereby a given artificial deviation from equilibrium of the bridge 11 is effected. This deviation is used to calibrate the system and to check that the measuring system operates properly. This calibration resistance has not been depicted in Fig. 1.

The means just described may be used e.g. for measuring the torque transmitted by the loaded shaft 25 of a tractor e.g. between the gearbox and the clutch, or its vibrations, either in product development work or as a pick-up means incorporated in the tractor and joined to the tractor's electronic control system, or to a load-indicating means in the tractor cab, for instance an indicating instrument or a lamp array.

In the following are stated the claims, various details of the invention being allowed to vary within the scope of the inventive idea thereby defined.

Claims

1. A means for transferring pick-up data, said means comprising an electrical measuring pick-up (18), such as a strain gauge assembly, a capacitor or equivalent, and electric power supply means (12,20,21) by which power is supplied to the measuring circuit, characterized in

that the signal obtained from the measuring circuit is supplied to a voltage/frequency converter (10) to be its input signal (U_{in});

that the output signal of said converter (10), the frequency (f_{out}) of which is dependent on the state of the pick-up (18), is supplied to antenna means (15); and

that said varying frequency (f_{out}) is wirelessly received with an antenna (22) and with receiving, demodulating and detecting means (23,24).

2. Means according to claim 1, characterized in that the pick-up is a strain gauge or a pair of strain gauges (Rv) which is a part of a bridge circuit (11), the equilibrium voltage (U_o) of said bridge circuit (11) being supplied over an amplifier (13) to become the input signal (U_{in}) of the voltage/frequency converter (10).

3. Means according to claim 1 or 2, characterized in that said voltage/frequency converter (10) is a micro-circuit, a capacitor (C) connectable across certain terminals ((6)-(7)) of same being used to set the central frequency (f_o) of the converter (10).

4. Means according to any one of claims 1-3, characterized in that the frequency band of the frequency-modulated measuring signal (f_{out}) to be transmitted by wireless technique is in the range about 50 to 150 kHz.

5. Pick-up means according to any one of claims 1-4, intended for indication and/or measurement of the load and/or the vibrations of

a power transmission shaft (25), such as a tractor shaft, e.g. to purposes of control, characterized in that the means comprises an electronic circuit board (16) and a miniature storage battery (20), these parts being together with a pick-up (18), such as a strain gauge pair, connected in conjunction with the shaft under measurement.

6. Means according to claim 5, characterized in that the components (10,11,12,13,14) on said electronic board (16) have been embedded in a protective compound (17) and that said electronic board unit (16,17) and the miniature storage battery (20) with bracket (19), if any, have been fixed around the shaft (25) under measurement with tape and/or with a particular protective housing.

7. Means according to any one of claims 1-6, characterized in that the antenna of the pick-up/transmitter means is a coil (15) with small dimensions.

8. Means according to any one of claims 1-7, characterized in that across and/or in series with the pick-up resistance (Rv) incorporated in the bridge circuit has been connected a known resistance and in its conjunction a switch by which it is possible to cause a given artificial deviation in the equilibrium of the bridge (11), and that said deviation has been applied towards calibration of the measuring system and checking of its operability.

0125433

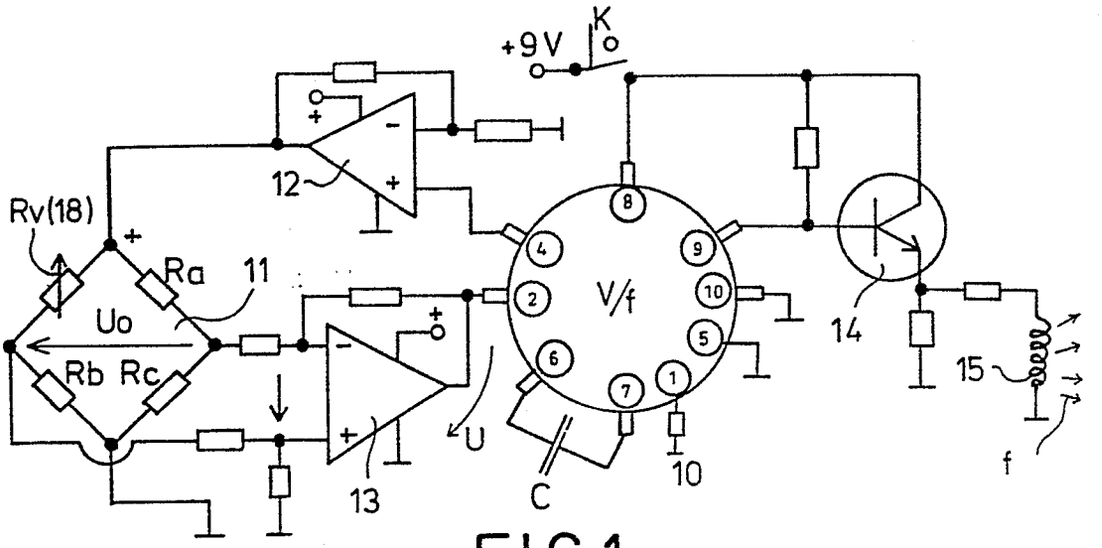

FIG.1

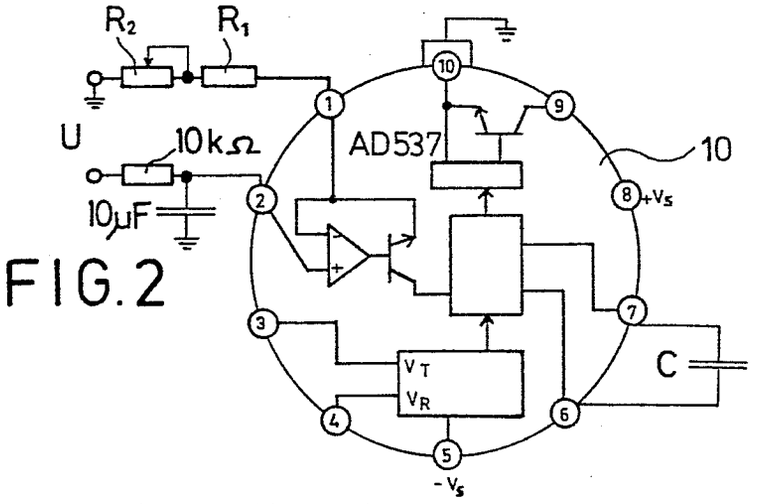

FIG.2

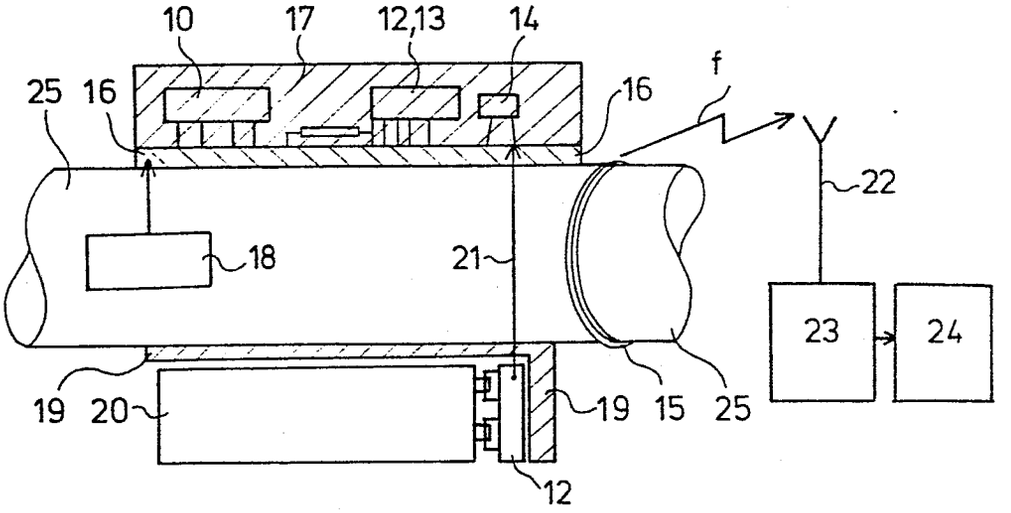

FIG.3

European Patent Office

EUROPEAN SEARCH REPORT

0125433
Application number

EP 84 10 3064

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	HOVERING CRAFT AND HYDROFOIL, vol. 14, no. 10, June 1974, pages 22,23, London, GB "Frequency modulated telemetry for instrumentation of rotating shafts" * Whole document *	1,2,4-7	G 08 C 19/12 G 08 C 17/00
Y	Idem.	3,8	
Y	ELECTRONIQUE & APPLICATIONS INDUSTRIELLES, no. 245, 1st December 1977, pages 23-26, Paris, FR D. THOUVAY: "Six applications pratiques de la conversion tension-fréquence" * Page 23, left-hand column, line 1 - right-hand column, line 3; page 26, right-hand column, lines 12-29; figures 1,8 *	3	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
Y	FR-A-1 584 976 (BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES) * Page 2, right-hand column, lines 12-33; abstract, points 1,7,8; figures 1,3 *	8	G 08 C
A	GB-A-1 585 175 (TALBOT MOTOR COMPANY) * Whole document *	1,2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06-06-1984	WANZEELE R.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82