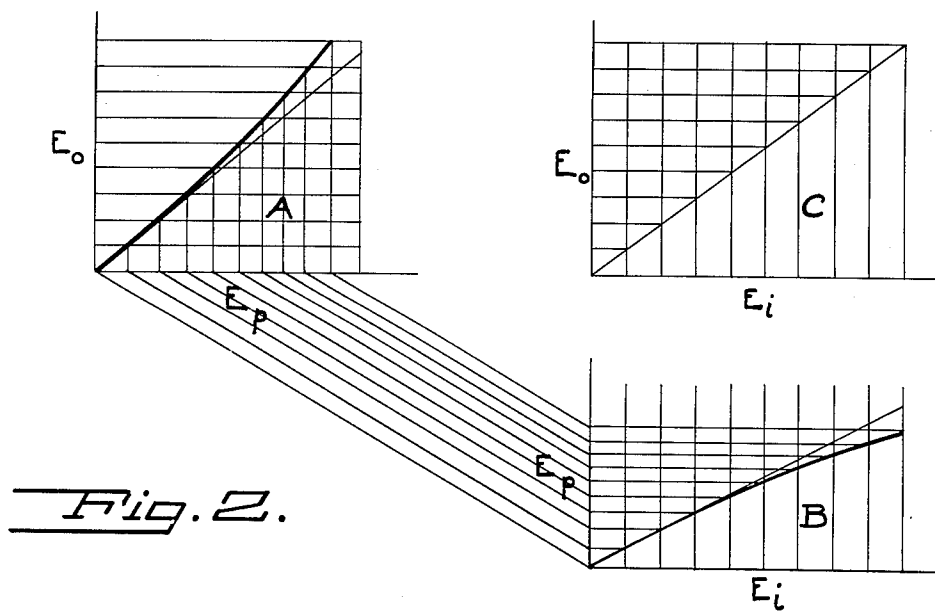
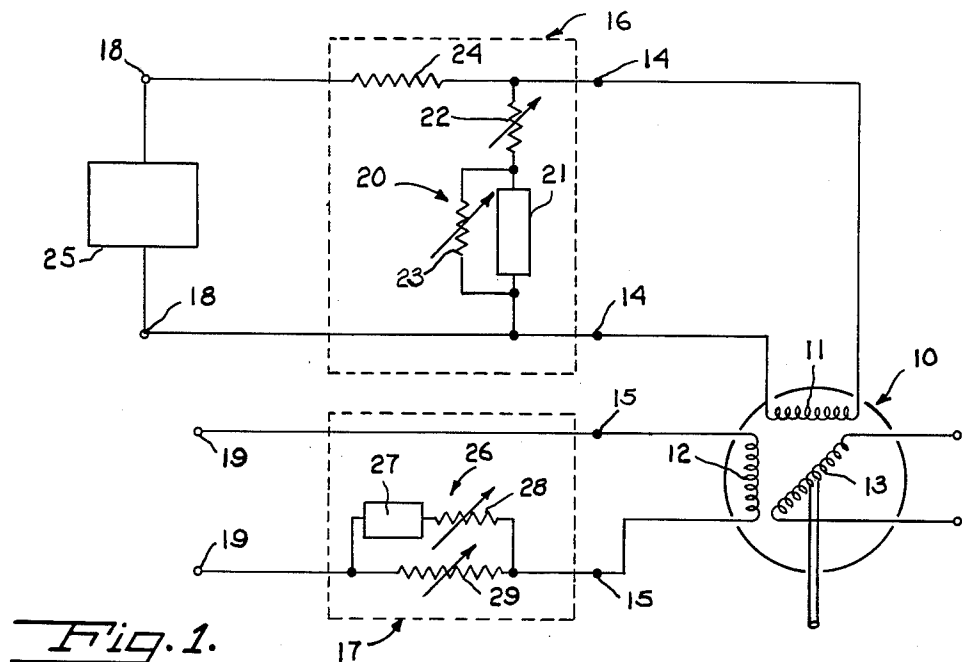


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J. STATSINGER
ELECTRO-MECHANICAL RESOLVERS

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ELECTRO-MECHANICAL RESOLVERS

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9 Claims. (Cl. 323—48)

This invention relates to electromechanical resolvers and correction devices therefor which compensate for variable transformation ratio between the primary and secondary windings.

It is well known that in resolvers having magnetic cores the transformation ratio between the primary and secondary windings is not always constant as the excitation voltage varies in magnitude between zero and a maximum.

The error resulting from this variation in transformation ratio between the resolver primary and secondary windings as the primary excitation varies is corrected by inserting a non-linear resistor in the primary circuit in a manner such that the resistor varies the excitation of the resolver primary winding for any input voltage to the combination of resistor and primary winding so as to make the output of the secondary winding proportional to the product of the input voltage and the sine or cosine of the rotor displacement angle.

For a more complete understanding of the invention, reference may be had to the accompanying diagram, in which Fig. 1 is a schematic diagram of a resolver and its correction circuits, and Fig. 2 shows graphically the operation of the invention.

With reference to Fig. 1, the primary windings 11 and 12 of resolver 10 are energized by voltages from terminals 14 and 15 respectively, which are the output terminals of the correcting circuits 16 and 17 respectively, inserted between the signal input terminals 18 and 19 and the respective primary windings 11 and 12. Circuits 16 and 17 both contain at least one non-linear element such that the voltage drop through the circuit increases non-linearly for increasing values of input voltage.

Circuit 16, for example, contains non-linear element 20 which includes the non-linear resistor 21 whose resistance decreases with applied voltage. Connected in series and in parallel with resistor 21 are the adjustable resistors 22 and 23, thereby providing means for varying the characteristics of the non-linear element 20 which is connected between terminals 14. A series resistor 24 is connected in one leg of the circuit 16 between terminals 18 and the non-linear element 20.

As the voltage E_p at the primary winding 11 increases, the voltage E_o induced in secondary winding 13 thereby increases non-linearly as shown in Fig. 2A, so that if the input signal, X , is impressed directly across terminals 14, the voltage induced in secondary winding 13 is not truly proportional to $X \cos \theta$, where θ is the angular displacement between the primary winding 11 and secondary winding 13, but is in error at the higher values of X .

With the circuit 16 connected as shown in Fig. 1 (terminated by primary winding 11), the voltage E_p at terminals 14 varies non-linearly with the input voltage E_i at terminals 18 as shown in Fig. 2B. As the voltage across resistor 21 increases, the impedance of the parallel connected primary winding 11 and non-linear element 20 decreases, thereby drawing relatively more current from

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the source of signal supply connected to terminals 18. This increased current causes an increased voltage drop through series resistor 24 such that the relationship of Fig. 2B results.

Fig. 2C shows the relationship between the input voltage E_i to terminals 18, and E_o the output voltage of rotor winding 13, and is constructed by combining Figs 2A and 2B.

If the source of signal supply voltage 25 has appreciable internal impedance, it is evident that the resistor 24 is not necessary and may be eliminated. The shape of the curve in Fig. 2B is adjusted by varying the resistors 22 and 23 to produce the desired linear characteristic of Fig. 2C, and under favorable conditions either one or both of the resistors 22 and 23 may be found unnecessary.

The alternative circuit 17 uses a non-linear element 26 containing non-linear resistor 27 whose impedance increases with applied voltage i. e. with the current through the resistor 27. An adjustable resistor 28 is connected in series with resistor 27 while another adjustable resistor 29 shunts both resistors 27 and 28, the non-linear element 26 being connected in series between terminals 19 and 15.

The action of the correcting circuit 17 may also be explained with reference to Fig. 2. The relationship between the voltage across primary winding 12 and the voltage induced in secondary winding 13 thereby, is shown in Fig. 2A where E_p is the primary voltage and E_o the output voltage induced in secondary winding 13.

Figure 2B shows the relationship between the voltage E_i at terminals 19 and E_p the voltage at terminals 15, when primary winding 12 is connected across terminals 15 to complete the series circuit. As the voltage E_i at terminals 19 increases, the current in the series circuit increases, but the impedance of the non-linear element 27 also increases so that the ratio of E_p to E_i decreases. By combining Figs. 2A and 2B the relationship between the input voltage E_i at terminals 19 and the output voltage E_o induced in winding 13, and shown by the straight line of Fig. 2C is obtained. The characteristic of curve 2B is varied by adjusting resistors 28 and 29 to produce the desired straight line result of Fig 2C.

The present invention has been described as correcting for increasing transformation ratios, but it is evident to those skilled in the art that the same method may be used to correct for decreasing transformation ratio by using non-linear resistors in the non-linear elements 20 and 26 which have characteristics opposite to those just described.

From the foregoing it will be seen that I have provided means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means connected to each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.
2. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means including resistor means connected to each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.
3. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means including a non-linear resistor connected to each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.
4. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensat-

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ing means including a non-linear element having a non-linear resistor connected to each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.

5. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means comprising a non-linear element having a non-linear resistor whose resistance decreases with applied voltage connected to each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.

6. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means in the circuits of each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.

7. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means including resistor means in the circuits of each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.

8. In a resolver, a pair of angularly displaced primary

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windings, a secondary winding and electrical compensating means comprising a non-linear resistor in the circuits of each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.

9. In a resolver, a pair of angularly displaced primary windings, a secondary winding and electrical compensating means comprising a non-linear element having a non-linear resistor in the circuits of each of said primary windings for compensating for variations in transformation ratio between said primary and secondary windings.

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