It is advisable to provide converters whose transducers are interrogated by pulse
signals with a linearly rising stepped scanning signal. Their output signal as a rule
consists of the transducers output-voltage amplitude. Therefore, the CD will then consist
of an amplitude comparator (AC), and the scanning-signal generator of a code-to-voltage
converter (CVC) switched synchronously with the transducers interrogation frequency. By
interrogating transducers in the middle of each "step" of the CVC output voltage it becomes
possible to eliminate the conversion results being affected by the circuit time character-
istics and the transducers output-voltage phase modulation, which is characteristic for
electromagnetic converters. In this case in the course of the transducer's interrogation
time step a sequential unit code is formed at the AC output and fed to the reversible counter.
Thus, the transducer's interrogation signal is used simultaneously as the TCC quantization
frequency, thus eliminating the error due to the lack of synchronism between the transducer's
interrogating frequency and that of the reference generator.

The above method was applied in a transformer-type converter [4]. When an eight-digit
code scale and multipolar lower-order transducers were used the converter resolution amounted
to 14 binary digits.

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RAISING THE SENSITIVITY OF ELECTROMAGNETIC ANGULAR
DISPLACEMENT CONVERTERS

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Angular displacement converters with an electrical reduction are not being increasingly
used [1]. In order to provide such converters with high precision it is necessary to raise
their sensitivity to the input signals, and this is attained by raising the electrical-re-
duction factor. In the existing converters [1] the latter is achieved mainly by raising the
number of pole windings, and this inevitably increases the converter's size. Below we examine
simple technical means for raising the converter's sensitivity without a substantial rise in
their overall dimensions.

These requirements are most completely met by primary converters of the transformer
type with inductively coupled multilayer butt-end windings and multislot electromagnetic
screens used as rotors. These converters have a relatively small conversion error, they
have no electrical sliding contacts, and they are simple in design and production technology.
The angular displacements of rotors with respect to the stationary primary and secondary
windings change the effective screening area of the pole windings, thus changing the electro-
magnetic coupling between the windings, which is converted into the phase of electrical
signals and then a digital code.

The electrical reduction factor is doubled for the same overall dimensions of converters
and the same number of pole windings and rotor slots if the primary and secondary windings
are relatively displaced by a quarter of their winding's pitch [2]. This produces the effect
of doubling the number of pole pairs, since the displacement of the rotor through an angle
corresponding to only half the winding pitch and not an entire pitch as previously, leads to
a complete output-voltage amplitude and phase variation period.

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For a normal operation of converters with an electromagnetic-screen rotor the supply-voltage frequency should lie within the range of several tens of kilohertz or higher. This impedes the conversion of the electrical-signal phase into a digital code.

Figure 1 shows the functional schematic of a displacements converter in which these difficulties have been eliminated to a considerable extent [3]. The primary converter 1 consists of one of the transformer-type converters described above which converts the angular displacement \( \alpha \) of the input shaft into an electrical signal, moreover, its secondary windings are displaced with respect to one another by the electrical angle of \( \pi/4 \), thus making the output-voltage amplitudes \( U_{\text{out}1} \) and \( U_{\text{out}2} \) respectively equal to

\[
\begin{align*}
U_{\text{out}1} &= U_0 \sin \alpha, \\
U_{\text{out}2} &= U_0 \sin (\alpha + \pi/4),
\end{align*}
\]

where \( \alpha \) is the number of winding poles; \( U_0 \) is the primary-winding supply voltage.

The converter circuit also comprises the hf voltage source 3, the low-frequency additional voltage source 4, the amplitude modulator 2, the amplifiers 5 and 6, the amplitude detectors 7 and 8, the selective amplifiers 9 and 10, the differential amplifiers 11 and 12, and the output phase-shifting device 13.

The converter principle of operation consists of the following. The modulator 2 inputs are fed with voltages from the supply sources 3 and 4. At the modulator output we obtain the amplitude modulated voltage

\[
U_m = U_0 (1 + m \sin \omega t) \sin \omega t,
\]

where \( U_0 \) is the supply voltage amplitude; \( m \) is the depth of modulation; \( \omega \) is the modulation frequency; \( \omega_t \) is the carrier frequency.

The voltage (2) is fed to the primary windings of the primary converter 1. Its output voltages represented by (1) will assume with (2) taken into consideration the form of

\[
\begin{align*}
U_{\text{out}1} &= U_0 (1 + m \sin \Omega t) \sin \alpha \sin \omega t, \\
U_{\text{out}2} &= U_0 (1 + m \sin \Omega t) \sin (\alpha + \pi/4) \sin \omega t.
\end{align*}
\]

These two voltages are fed through the amplifiers 5 and 6 to the amplitude detectors 7 and 8 and then to the selective amplifiers 9 and 10. The amplitude modulated voltages \( U_{\text{out}1} \) and \( U_{\text{out}2} \) are then detected, their hf components are filtered out, and the selective amplifiers (9 and 10) output voltages are represented as

\[
\begin{align*}
U_{\text{C}1} &= kU_0^2 (m \sin \Omega t - m \cos 2\alpha \sin \Omega t), \\
U_{\text{C}2} &= kU_0^2 (m \sin \Omega t + m \cos 2\alpha \sin \Omega t),
\end{align*}
\]

where \( k \) is the transfer factor of the amplitude detectors.

The voltages (3) are fed from the amplifiers' (9 and 10) outputs to one of the inputs of the corresponding differential amplifiers 11 and 12. The second inputs of these amplifiers are fed with the low-frequency voltages from the voltage source 4. The differential amplifiers 11 and 12 subtract from the voltages \( U_{\text{C}1} \) and \( U_{\text{C}2} \) their first terms \( kU_0^2 m \sin \omega t \) and, therefore, at the output of these devices there appear voltages represented at

\[
\begin{align*}
U'_{\text{out}1} &= kU_0^2 m \cos 2\alpha \sin \Omega t, \\
U'_{\text{out}2} &= kU_0^2 m \sin 2\alpha \sin \Omega t.
\end{align*}
\]