Contactless inductive current collectors are now beginning to be used for investigating rotating components. Such collectors have various advantages as compared with those of the contact type [1-4]. The applied mechanics department of the Gor'kii Agricultural Institute has developed several designs of contactless inductive current collectors, which have been used for investigating loads in the transmission components of GAZ-51, GAZ-53, and GAZ-66 automobiles during several years under different road conditions. It was thus found that the current collectors do not contribute any interference to the recording of the tested process, they are reliable in use and have a long life. The reliability and durability of induction current collectors have been noted in the works of NAMI (State All-Union Automobile and Automobile Engines Scientific Research Institute) [2]. All this shows that such current collectors should be widely used for investigating stresses, temperature, and other processes in rotating details.

Inductive current collectors can be divided into two types which differ by the position of their windings and transformer cores. In the first type the windings and the cores are placed concentrically [1, 2], in the second type they are parallel to each other [3, 4]. The designs developed by us belong to the second type.

In order to provide good inductive coupling in the current collectors' transformers, their cores are made in the shape of rings of magnetically soft materials. Standard components made of such materials and produced by our industry are often used for this purpose. In order to obtain a true picture of loading in testing automobile transmissions, it is necessary that the moments of inertia of the current collectors' rotating components should be minimal and the dimensions of the feed-through collectors should be suitable for attaching them to a transmission without changing the shape or size of its components. This is necessary because an automobile transmission consists of a single oscillatory system whose parameters determine the loading of its component elements. Therefore, in many instances it is disadvantageous to use standard magnetically-soft components, and it is sometimes even impossible to use them in manufacturing feed-through current collectors.

In the previously-described version of an end-face inductive current collectors [3, 4] the transformer cores consisted of ferrite F600 rings made specially for the purpose. Two such current collectors with an 8ANCh-7 m amplifier and an N-700 oscillograph were used for measuring the torque on the semi-axles of a GAZ-51 automobile.

As a result of investigating and applying these current collectors we arrived at the following conclusions.

1. No interaction between transformers was observed with appropriate screening and a spacing of 15 mm between them [3].

2. When the spacing between inadequately screened transformers is reduced to 7 mm, the current in the supply transformer induces an emf in the windings of the measuring transformer, thus producing a displacement of the oscillograph zero line by a constant amount. With a further reduction of their spacing a positive coupling may arise.
TABLE 1

<table>
<thead>
<tr>
<th>Transformer</th>
<th>Winding</th>
<th>Number of turns</th>
<th>Wire diameter in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring</td>
<td>Primary 3</td>
<td>250-350</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Secondary 4</td>
<td>500-1000</td>
<td>0.1</td>
</tr>
<tr>
<td>Supply</td>
<td>Primary 6</td>
<td>100-160</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Secondary 7</td>
<td>300-400</td>
<td>0.2</td>
</tr>
</tbody>
</table>

3. The bridge can be balanced with an appropriate device available in a strain-gauge amplifier. Balancing by means of the device located on the rotating component [3] entails various difficulties.

4. By adjusting the clearance between the transformer cores and the current collectors we attained a position in which the interference due to variations in the clearance produced during rotation by inaccurate manufacture [4] became completely unnoticeable on the oscillogram at the required value of the useful signal. The clearance between the transformer cores has to be made very large, since ferrite is difficult to machine. The clearance between the cores of the measuring transformer in one of our current collectors had to be raised to 3.25 mm. The current collector's efficiency was then fully preserved.

For further investigation of transmission we designed and made feed-through current collectors for the main gearbox shaft and the propeller shaft of a GAZ-51 automobile. Since the propeller shaft has a large diameter, we found it impossible to make ferrite rings for its feed-through current collector without special equipment. Therefore, we investigated the possibility of using carbonyl iron, or structural steel for the cores of the current-collectors' transformers.

Figure 1 shows a current collector with its cores made of R-10 carbonyl iron (N. P. Sal'nikov participated in designing this type of current collector). Since components pressed out of carbonyl iron are weak mechanically, we pressed the carbonyl iron powder 2 straight into a special steel jacket 11, which served at the same time as a screen, and then subjected the carbonyl iron together with its jacket to heat treatment and machining.

Shaft 8 and the casing components 9, 10, and 12 were made of duralumin. The core rings were insulated from the steel shafts by means of brass bushings. Expansion rubber bushing 5 eliminates play in bearings 1. The transformer coils' winding data which are shown in Table 1 were selected experimentally to produce a maximum signal.

All these current collectors were subjected to a number of tests.

1. The ratio of the voltage $U_{out}$ across the secondary transformer winding to voltage $U_{in}$ across its primary winding was evaluated for various types of current collectors, the same clearances between the cores, and the same load resistances, but different frequencies of the current flowing through them. For this purpose we used a ZG-10 audio-frequency oscillator and a VZ-2A tube millivoltmeter. The instruments were connected as shown in Fig. 2. Graphs were plotted from the data thus obtained (see Fig. 2).

2. Ratio $U_{out}/U_{in}$ was determined for a current collector whose transformers had a primary winding core of ferrite F-600 and a secondary core of alsifer TCh-60 p, with clearances of 3.25 mm and 1.5 mm for the measuring and supply transformers, respectively. Measurements were made at different load resistances and frequencies. It was found that with a reduced load resistance the efficiency of the current collector decreases and the shape of the curve changes.