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Application of the Inverse Wiedemann Effect to Torque Variation Recordings.

Part II.

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In the previous paper,(1) the author described a method of recording the variation of torque acting on a rotating shaft by the application of the inverse Wiedemann effect. The method was as follows:—If a longitudinal electric current (D. C.) is passed through part of the shaft by means of contact brushes, the longitudinal magnetisation of the shaft part varies as the torque varies. This magnetic variation can be recorded by connecting a coil wound over the shaft part to an oscillograph. This method enables us to record very quick variations of torque, but it is not suitable for recording very slow changes, because, if the changes are very slow, the E.M.F. induced in the coil is very small. We can record such slow variations of torque, sending an A.C., instead of D.C., through the shaft part. In doing so, an A. C. of a certain wave form is induced in the coil, of which amplitude changes as the torque changes.

(1) Application of the Inverse Wiedemann Effect to Torque Measurements and to Torque Variation Recordings. Rep. Aeronaut. Research Inst. Vol. IV, No. 52, (1929).

Therefore, if the torque is changing, the row of tops of the record of such an A. C. gives the torque curve. The wave form changes if the strength or the frequency of the longitudinal current changes. Fig. 22 in the previous paper shows the wave form when a 50 cycle A. C. of 42.5 amperes was passed through a 3 cm. shaft and Fig. 1 in this paper shows the wave form when a 600 cycle A. C. of 20 amperes was sent through the same shaft.

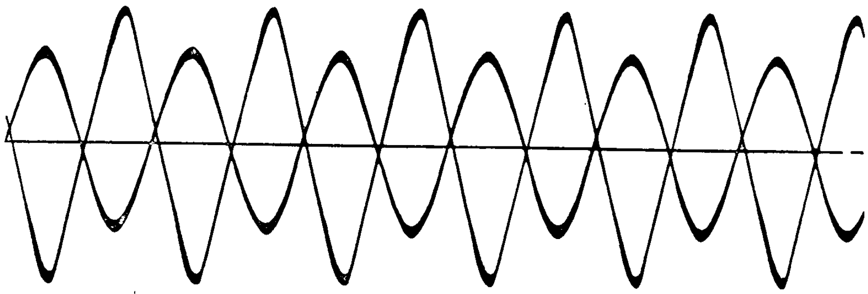

Fig. 1.

(The curve of smaller amplitude is the 600 cycle A.C.)

An example of this kind of record is shown in Fig. 24 in the previous paper, in which case the period of torque variation was 1.6 seconds and the longitudinal current was 50 cycle A.C.

In this method, the number of cycles of the longitudinal current must be much greater than the frequency of the torque variation—at least ten times. Therefore, if the 50 cycle A.C. is used, torque changing more quickly than 300 times per minute cannot be recorded with accuracy. If it is wanted to record still quicker changes, we must use an A.C. of still higher frequency. The author has taken some records of the variations of torque on a shaft rotated by a six cylinder automobile engine with the same arrangement explained in the previous paper (p. 431), sending a 600 cycle A.C. through the shaft.

The exact number of cycles was 620 ± 3 throughout the experiments. The number of turns of the coil was 100 and the amplitude of the spot of the oscillograph was reduced to a suitable degree by inserting a certain amount of resistance. The results of the calibration of the relations between the torque and the amplitude made by attaching twisting arms to both the ends of the whole shaft are shown in Fig. 2.

(The curving is considerable, because the longitudinal current was not sufficiently strong.)

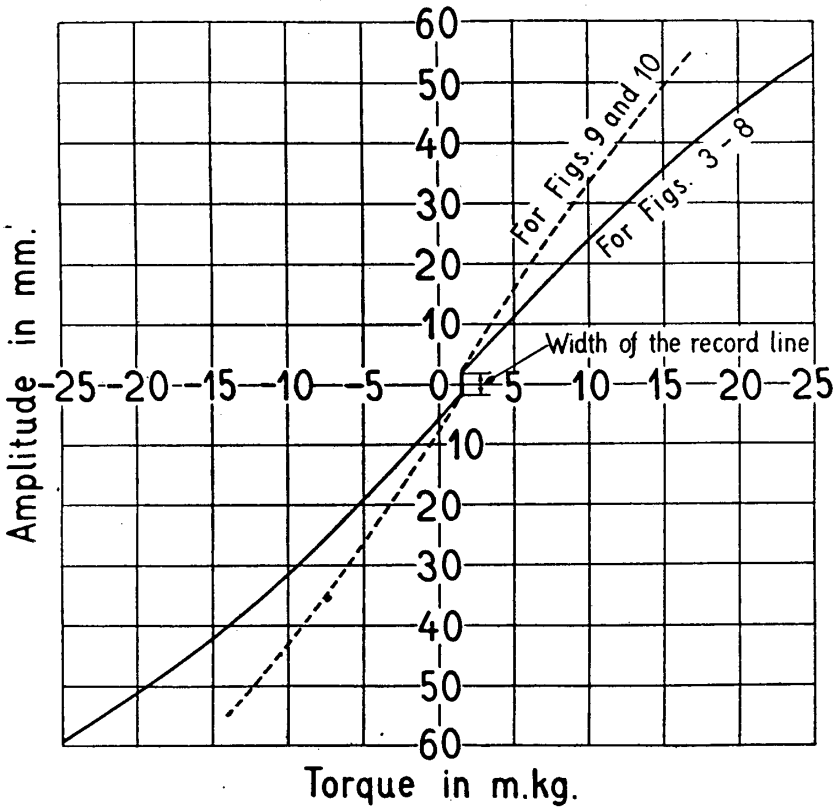

Fig. 2.

The records shown in Figs. 3—8 were obtained under the same conditions as in Figs. 12—17 in the previous paper, the number of rotations being in some degree smaller. In parts of negative torque, the phases of the recorded waves shift by half the wave-length. This can be clearly seen in Figs. 5 and 7 by comparing the positions of the wave tops with the parallel straight lines drawn at equal intervals. As was explained in the previous paper, the regular periodic curves just below the centre line show the primary currents of the ignition induction coil and their upward jumps indicate the times of sparking. The figure above each jump shows the number of the cylinder which was ignited. The downward projections marked D6 show the top dead centres of the cylinder No. 6 before the explosion strokes and those marked D′6 give the same before the suction strokes. The short straight lines at the bottom indicate timings of 1/50 second.

Figs. 9 and 10 are records of when the shaft was rotated from the dynamometer side at a speed of about 120 R.P.M., the cylinders being compressed. In the case of Fig. 10, the cylinder No. 6 worked out no compression, the plug being drawn off.

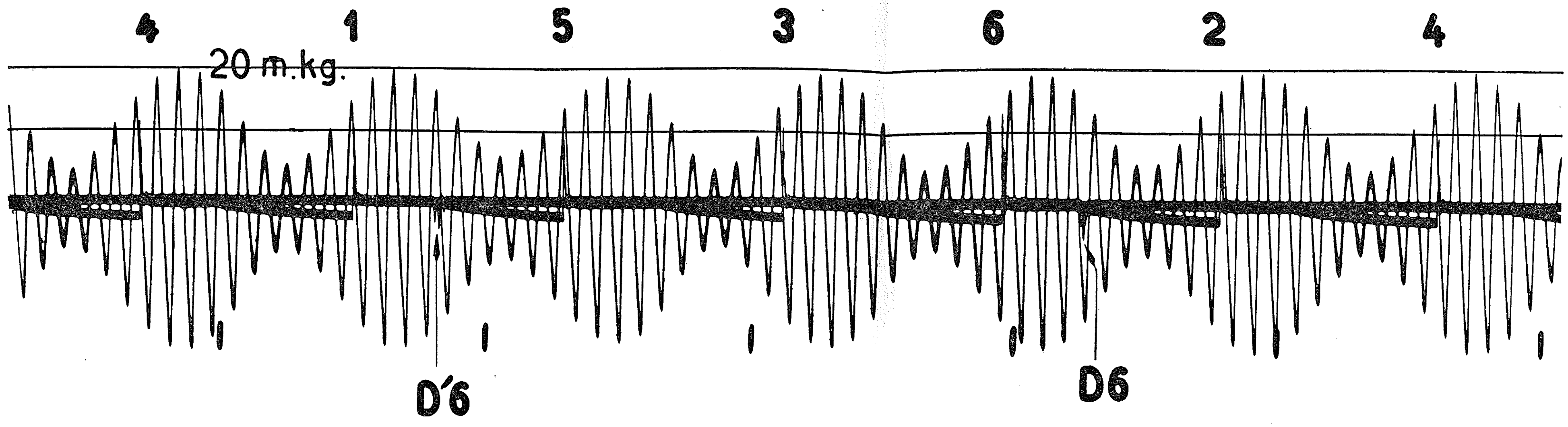

Fig. 3. Ignition advanced. R. P. M.: 1220. Mean torque: 15.1 m. kg.

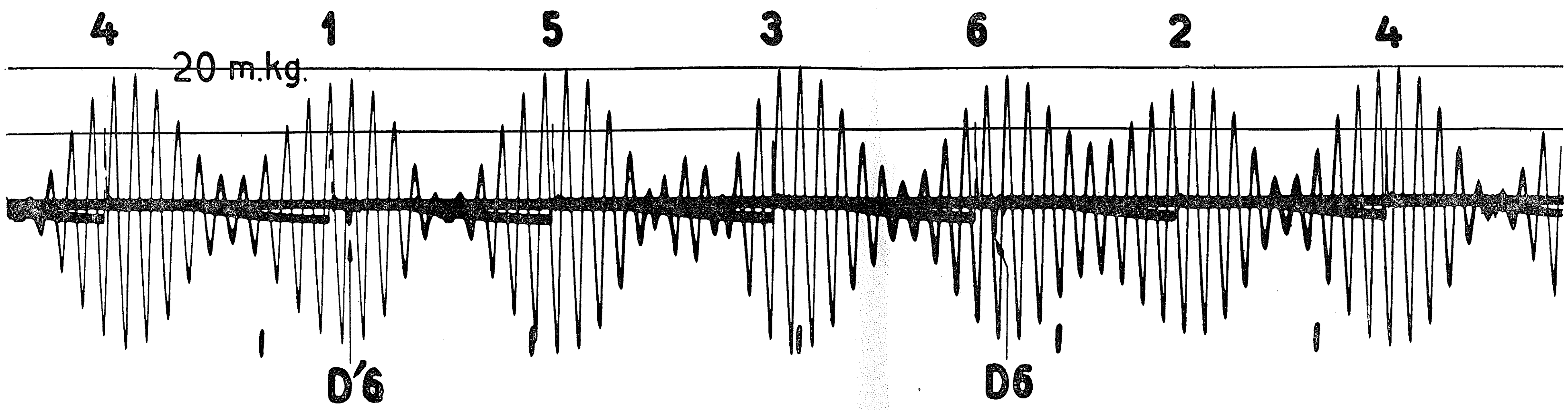

Fig. 4. Ignition retarded. R. P. M.: 1240. Mean torque: 13.0 m. kg.

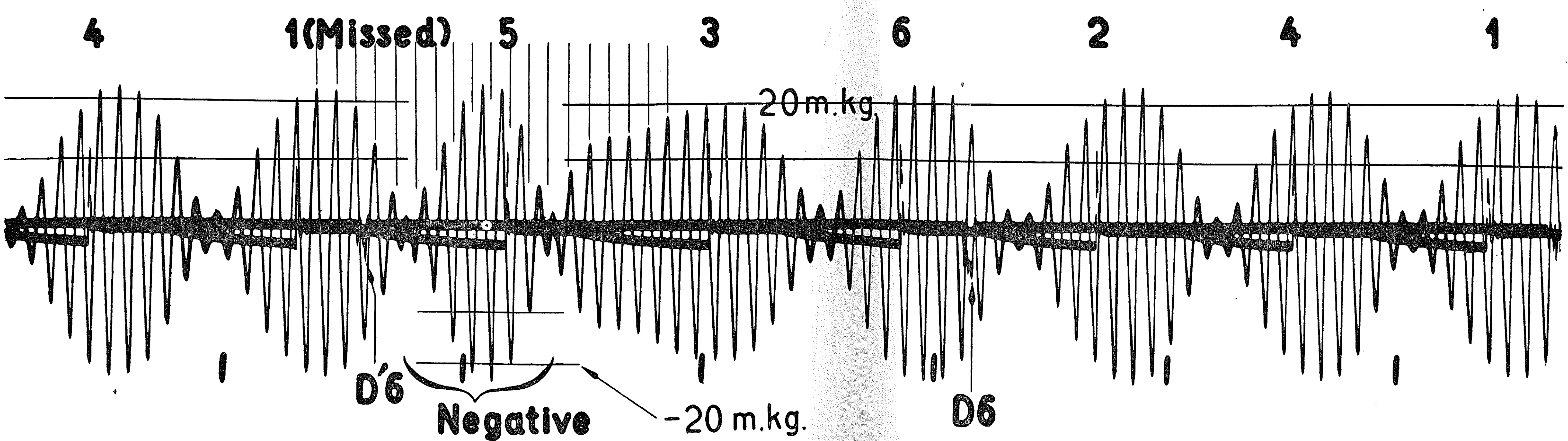

Fig. 5. Cylinder No. 1 missing. R. P. M.: 1180. Mean torque: 12.3 m. kg.

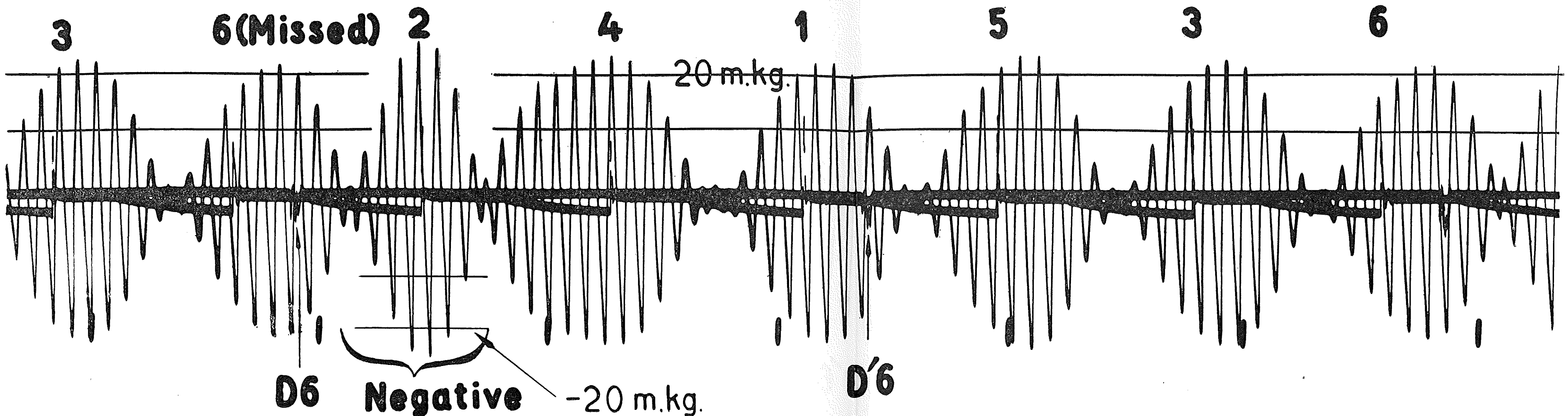

Fig. 6. Cylinder No. 6 missing. R. P. M.: 1210. Mean torque: 12.3 m. kg.

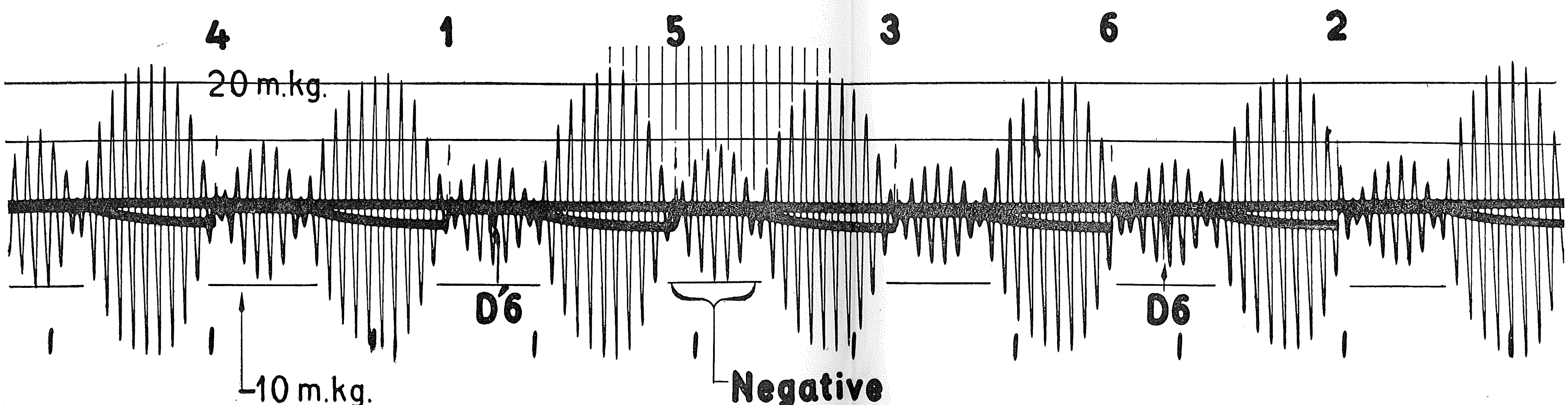

Fig. 7. Ignition advanced. R. P. M.: 720. Mean torque: 9.7 m. kg.

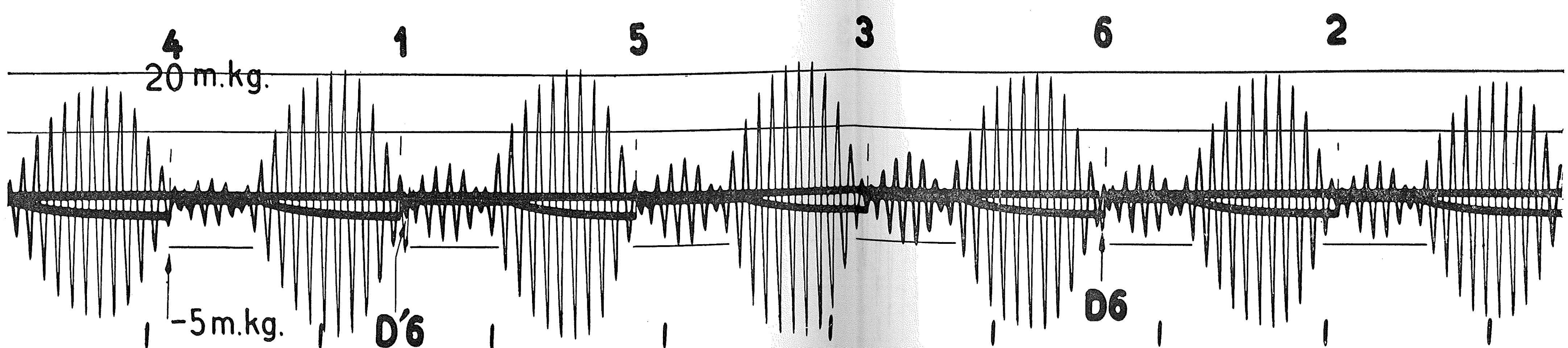

Fig. 8, Ignition retarded. R. P. M.: 725. Mean torque: 9.8 m. kg.

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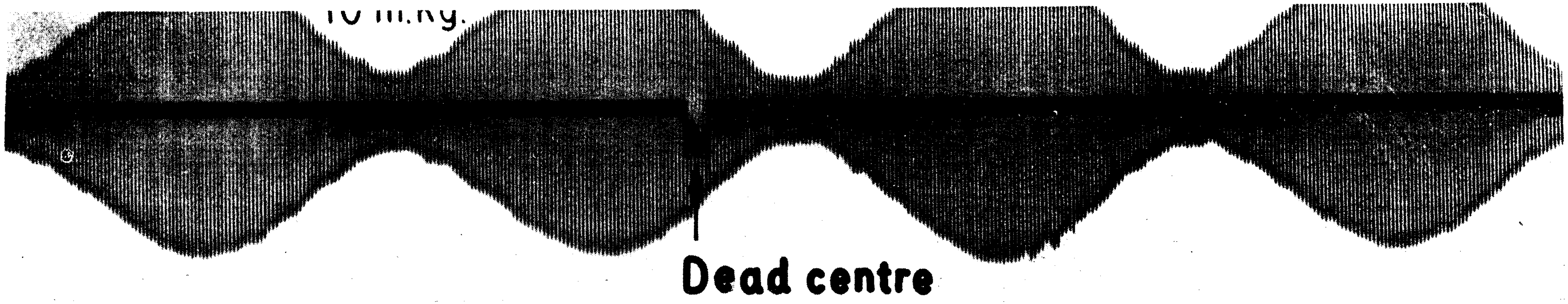

Fig. 9. Cylinders being compressed. R. P. M.: 119.

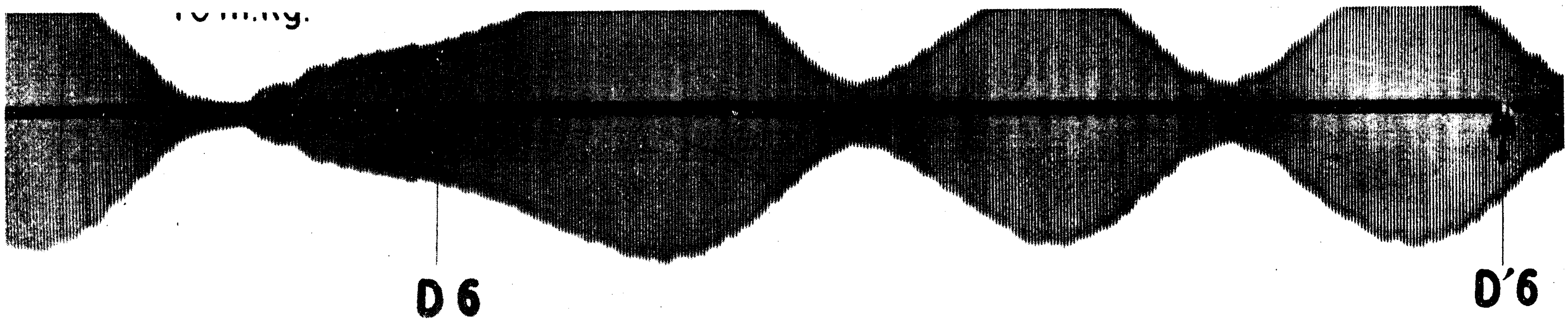

Fig. 10. Ditto, one cylinder leaking. R. P. M.: 113.

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