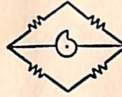


**CAMBRIDGE INSTRUMENT COMPANY, LIMITED,**MANUFACTURERS OF  
MECHANICAL & ELECTRICAL  
INSTRUMENTS OF PRECISION.

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LC/C

YOUR REF.....

IN REPLY PLEASE QUOTE.....

The Professor of Physics,  
Escola Polytechnica de Sao Paulo,  
SAO PAULO, BRAZIL.*Escrever  
catalogo  
pedidos*

November 5th 1934

Dear Sir,

A USEFUL LABORATORY INSTRUMENT.

In a physical laboratory there are many occasions when some convenient means of recording rapidly varying phenomena is required. When such phenomena can be arranged to make or break an electric current the Chronograph illustrated overleaf is particularly useful, and is being increasingly used in this connection all over the world.

You will see that two patterns are made. Both models are of simple design, compact and easy to use. They are not luxury instruments, but like galvanometers, resistances and bridges, should form part of the standard equipment of every up-to-date physics department. Our new List No.100 describes the instrument fully and also other physics apparatus. We shall be glad to send you a copy.

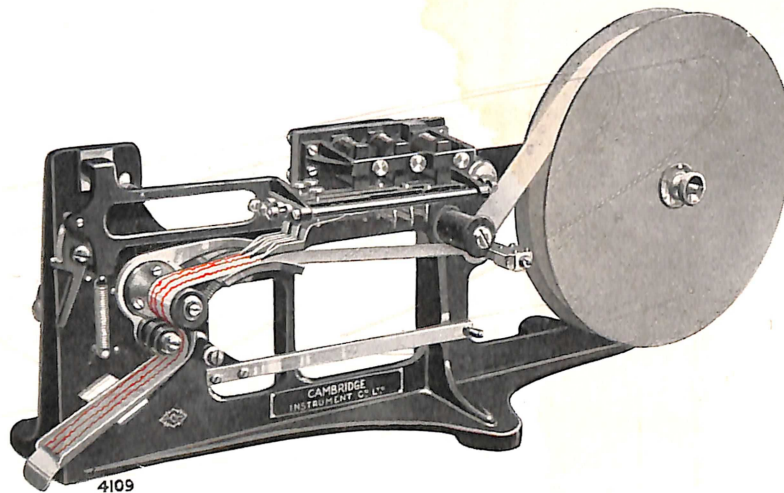
Yours faithfully,

for CAMBRIDGE INSTRUMENT COMPANY LTD.

Director.

# CAMBRIDGE CHRONOGRAPHS

## Three and Six Pen Patterns



**I**N connection with many scientific observations, it is necessary to obtain records of the occurrence of events or phenomena. When such events can be arranged to cause the making or breaking of an electric circuit, the instrument illustrated will be found particularly convenient. A band of paper (25 mm. wide by 167 metres long) is drawn at a normal speed of 25 mm. per second under three pens attached to the armatures of three electro-magnets. One pen may be connected to time-marking mechanism to provide a time scale, while the other pens record the phenomena under observation, or one pen may be used to mark fiftieths of a second, one to mark seconds, and one to record phenomena. To illustrate the wide application of the instrument, portions of some typical records are reproduced full size on the opposite page.

**Record No. 1. Determination of Chronometer error by wireless time signals.** Line B is formed by the pen of an Abraham-Bloch Oscillograph, showing "scientific time signals" received at Khartoum by wireless from Bordeaux, with associated atmospheric signals; Line A shows hand-operated signals from an observer listening to the Bordeaux signals; Line C is formed by the contact-making sidereal chronometer being tested. (*Reproduced by courtesy of the Department of Scientific and Industrial Research.*)

**Record No. 2. Comparison of Pendulum Clocks by wireless time signals.** Line D shows rhythmic signals (61 per minute) from Paris "Pendulette" scientific time signals; Line E shows "second" beats of a "Shortt" No. 6 mean time pendulum; Line F shows "second" beats of a "Riefler" pendulum clock giving local sidereal time. (*Reproduced by courtesy of Rear-Admiral Fontaine.*)

**Record No. 3. Test of Tuning Fork giving 50 vibrations per second.** Line G shows vibrations of tuning fork under test; Line H shows record from 1/10th second time marker; Line J shows standard seconds.

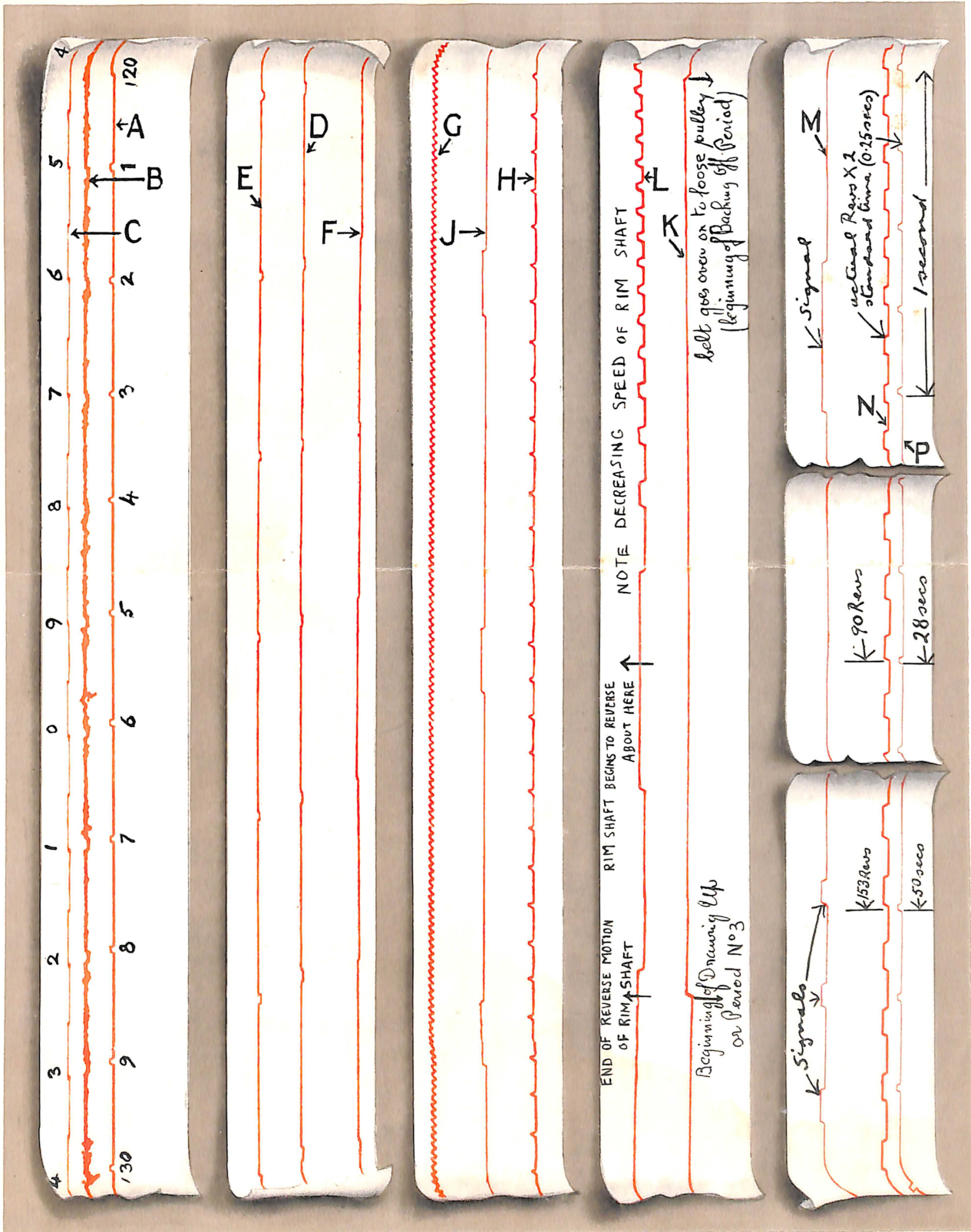
**Record No. 4. Timing of Self-acting Cotton Spinning Mule.** Line K shows the commencement and conclusion of the "backing off" period; Line L shows the time taken and the revolutions of the rim shaft—the decreasing speed until the reversal of the shaft is clearly shown. (*Reproduced by courtesy of Messrs. Atherton Mills, Ltd., Lancashire.*)

**Record No. 5. Retardation Test of a Turbine Generator (uncoupled).** Line M gives correlating signals; Line N shows the revolutions of the shaft; Line P shows standard time signals (0.25 sec.). From a study of the record it is seen that a retardation of 4.8 per cent. took place during an interval of 22 seconds. (*Record obtained by Mr. Perry A. Borden at the Hydro-Electric Power Commission Laboratories, Toronto.*)

The records reproduced were obtained on a three-pen Chronograph of the type illustrated. For investigations involving a larger number of separate signals, a six-pen Chronograph of similar design can be supplied, giving records on a strip of paper 5.5 mm. (2.2 inches) wide.

# SOME TYPICAL RECORDS

Actual size



No. 1

No. 2

No. 3

No. 4

No. 5

$$h_{\mu\nu} = \text{average} = \langle g_{\mu\nu} \rangle$$

Edvito per cura  
dal                     

||  
||

$(u, v)$

$[u, v]$

$\vec{u} \cdot \vec{v}$   
 $\vec{u} \times \vec{v}$

$\vec{u} \cdot \vec{v}$   
 $\vec{u} \times \vec{v}$