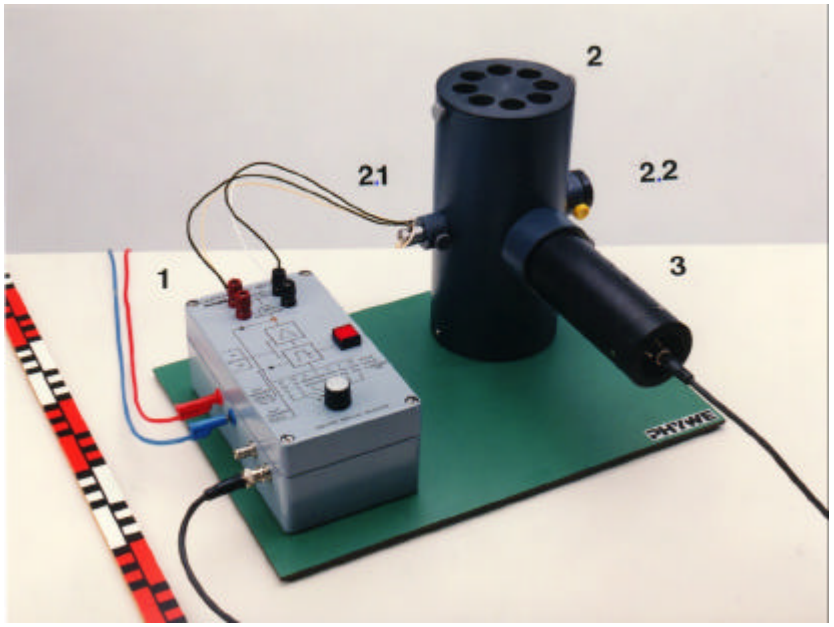


Fig.1 Ignition delay measuring unit for bridge igniter.

1. PURPOSE

When a current impulse is switched on an electric igniter, a delay between the generation of the impulse and the occurrence of the ignition flame can be observed. If the ignition current remains under a certain lower value, the amount of heat conveyed by the bridge wire is not sufficient to trigger the reaction of the pyrotechnic squib, his means that the squib remains passive. If the motor ignition delay effects are to be examined for the ignition of a PVC-Plastisol Solid Propellant in a demonstration rocket motor, precise knowledge of the ignition dependence of the igniter as a function of the ignition current or the ignition energy is necessary. This device is able to record the internal pyrotechnic ignition, the destruction of the heating wire and the occurrence of an ignition flame for different ignition currents. The values are displayed by means of a digital storage oscilloscope.

2. CONSTRUCTION

The ignition delay measuring unit consists of a current pulse generator (1), the measuring chamber (2) and the optical sensor (3).

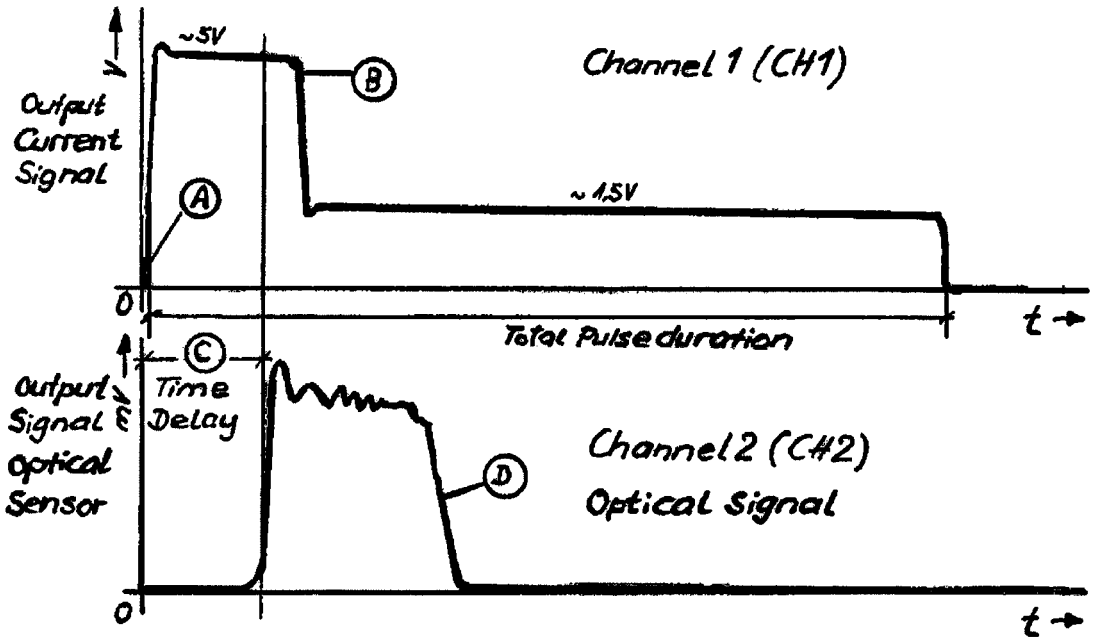
The electric igniter (squib) to be tested is fixed in the measuring chamber (2) by means of the plug-in holding device (2.1). It is connected with the output terminals of the pulse generator. The particles that are released by the squib are picked up by a collecting device (2.2) so that the front lens of the optical sensor (3) is not damaged. The measuring chamber is designed in such a way that the sensor cannot be influenced by external light and that ignition particle remain inside the chamber. The measuring unit should be operated under the fume hood (exhaust) since organic lead compounds in the vapour state are emitted.

The pulse generator (1) is driven by an external electronically controlled power supply unit (0...30V/4A, DC). The measuring signals are recorded and stored by digital storage oscilloscope (20 Ms/s minimum). The VIS-IR-photocell unit with Si-photocell that is also used for measurements on igniter charges and solid propellant charges serves as the optical sensor (3). The storage oscilloscope described above records the optical ignition signal received.

3. FUNCTION

The pulse generator consists of a timing unit, the pulse time of which can be switched from 5 ms to 10 s in seven steps. During the time when the pulse is generated a certain power stage is selected so that, depending on the selected ignition pulse, defined ignition current is passed into the igniter. Ignition pulse time and current are co-ordinated in such a way that with great certainty an ignition occurs current while current flows. Only in switch position 180mA/10s (total pulse duration) is an ignition impossible since the generated ignition energy is not sufficient. The electric circuit is designed in such a way that, if the flow of current is interrupted during the ignition pulse time (A) (burning out of the heating wire), another electric signal is generated (B).

Fig.2 Typical output signal diagram



We get three informations:

3.1 The point of time when the current starts to flow in igniter (A).

3.2 Delay until the interruption of the heating wire of the igniter (B).

3.3 Delay between the point of time when the current shafts and occurrence of an ignition flame (C) which can evaluated and e burning time (D).

4. APPLICATION

Before operation the equipment is to be arranged according to Fig.3

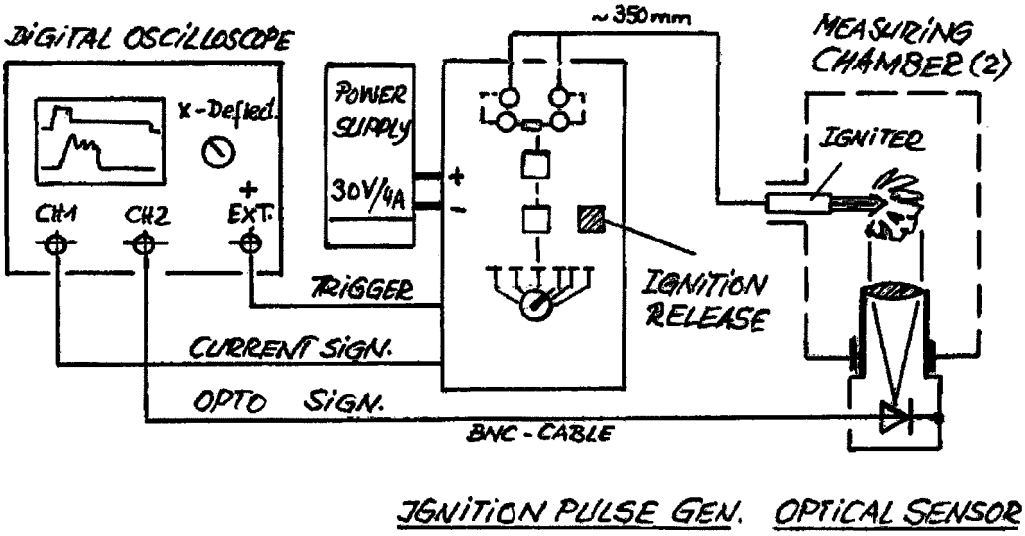


Fig.3 Wiring diagram for measurement of igniter delay time.

Working Procedure:

- Connect the power supply with the pulse generator and switch it on. Set it to 30 V DC; maximum current: 4 A.
- Connect by means of BNC cables:
  Trigger OUT to Oscilloscope Ext.In (+)
  Current signal OUT to CH1 IN (+2V/DIV)
  Current signal OUT to CH2 IN (+0.2V/DIV)
- Switch the ignition pulse selector to 0.7A and select x deflection 5ms/DIV.
- Switch on LOAD SIMULATION and hit the key ”Ignition”. Set the trigger level so that the trace is reliably started. Set the 0-positions of the tracer.
- Remove the connection to the LOAD SIMULATION.
- Shorten the connection cable of the test igniter to about 35 cm.
- Plug the igniter in the holding device, fix the connecting cable.
- Select the first measuring point (4A/x-defl. 0.5ms).
- Connect the igniter to the output terminals of the pulse generator.
- Set the oscilloscope on RESET passion.
- Trigger the measurement by applying the IGNITION key.
- Document the measuring results.
- Carry out 3 measurements per measuring point and calculate the mean value.

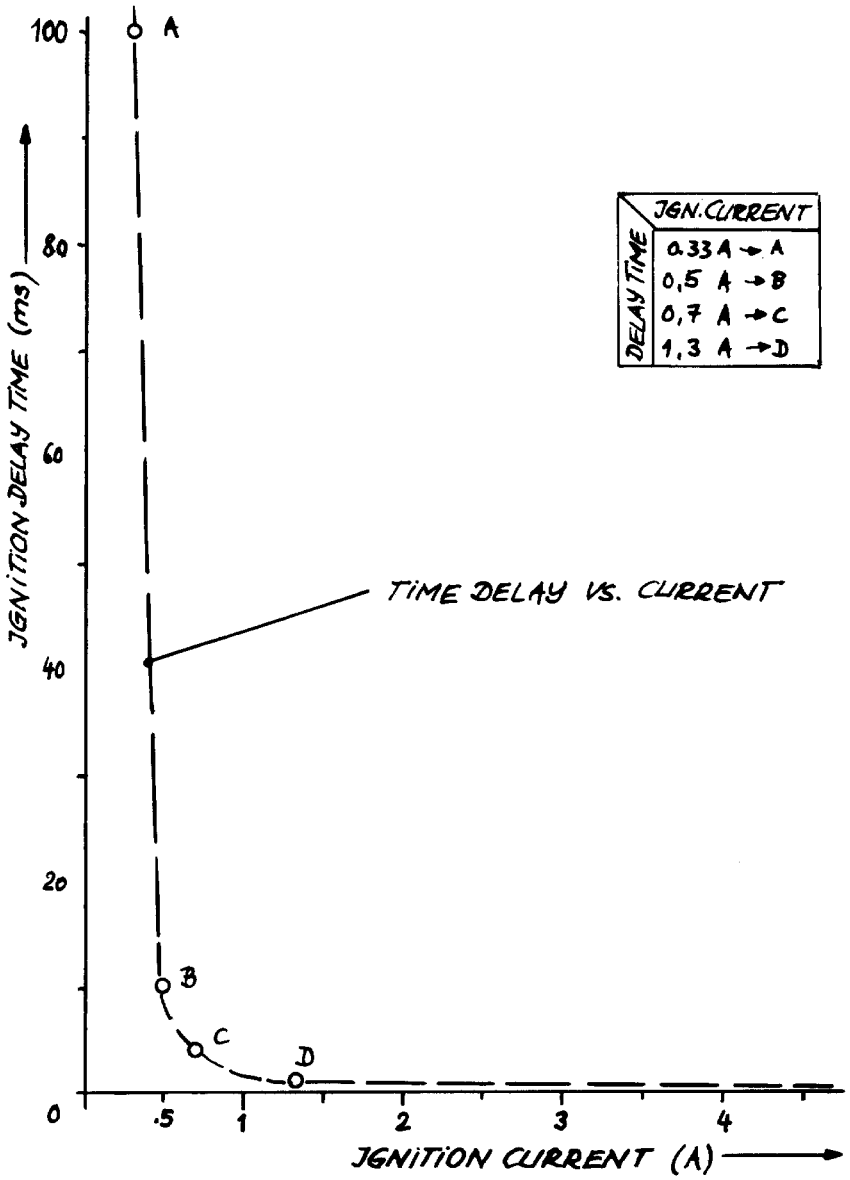
5. DATA

Input voltage: 30 V DC (Current Adjust 4 A)
Output current pulses / time (nominal)

Pos.	1	0,18 A	10 s
	2	0.33 A	1 s
	3	0.5 A	100 ms
	4	0.7 A	50 ms
	5	1.3 A	10 ms
	8	2 A	10 ms
	7	4 A	5 ms

Tolerances:	- current max.	± 8%
	- time	±3%

Output:	Current signal:	appr. + 6V/1K
	Trigger signal:	appr. + 5V/1K


100
80
60
40
20
0
A
B
C
D
.5
1
2
3
4
IGNITION DELAY TIME (ms)
IGNITION CURRENT (A)
TIME DELAY VS. CURRENT
JGN.CURRENT
DELAY TIME
0.33 A → A
0,5 A → B
0,7 A → C
1,3 A → D