the use of a high speed recording camera. The method by which the experiment was made will be described in detail later. As a result of the lack of a sound level meter, a mean of estimating the sound level from the pressure traces had to be found. This was consider as a rough indication of the effectiveness in noise suppression of each setup.

Description of apparatus

Fig 1. Shows the test bed and its facilities, the engine was the J.A.F. 16 E two-stroke air-cooled crankcase scavenge engine coupled to a d.c. dynamometer. The engine was loaded electrically by means of a bank of heaters mounted on the wall. The flywheel end of the engine was used to drive a marker disc which gave the pulses in accordance with the crank angle of the engine while it was running. These pulses were amplified by a marker amplifier which inturn gave its output to the oscilloscope, so that the position of the piston can readily be recognised.

The output from the transducer was amplified by a charge amplifier and the amplified signal fed to the oscilloscope. Therefore, the pressure trace from the transducer was shown on the screen the same time

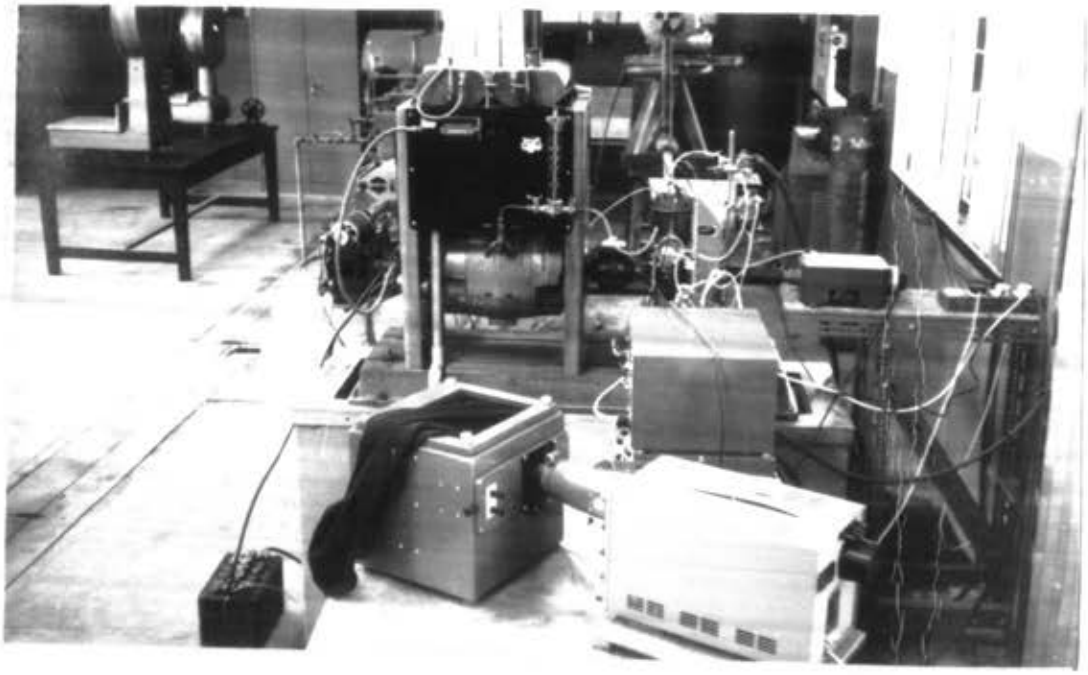


Fig. 1

Equipment Layout

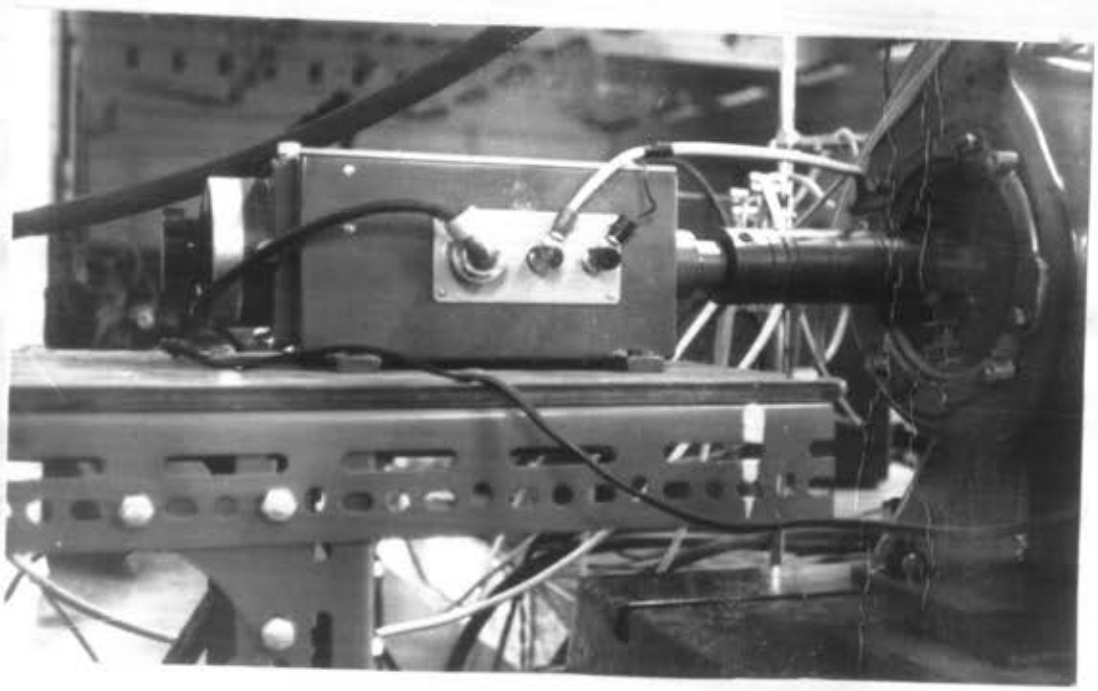


Fig. 2

Marker Disc Unit

as the position of the piston could be detect from the marker trace appeared together.

The Marker Amplifier and the Marker Disc Unit

Fig. 2. Shows the marker disc unit as it was coupled to the flywheel of the engine. The unit was driven from the crankshaft by a very stiff rubber coupling. Any unintentional torsional vibration between the unit and the engine was avoided. This type of coupling has no back lash and is torsionally very stiff while allowing the necessary flexibility to accomodate misalignment.

The marker disc unit comprised a robust box with four fixing lugs. The shaft was mounted on ball-races and carried a degree marker disc. The disc was of tufnol with stalloy inserts at 20 degree intervals round the periphery, the T.D.C. position was identified as the central insert of a group of five spaced at 10 degrees. An electro-magnetic pick-up was attached very close to the disc so that a sharp pulse was generated as each insert passed the pole piece. The disc and pick-up are shown in Fig. 3 with the marker amplifier.

The marker amplifier is provided with two

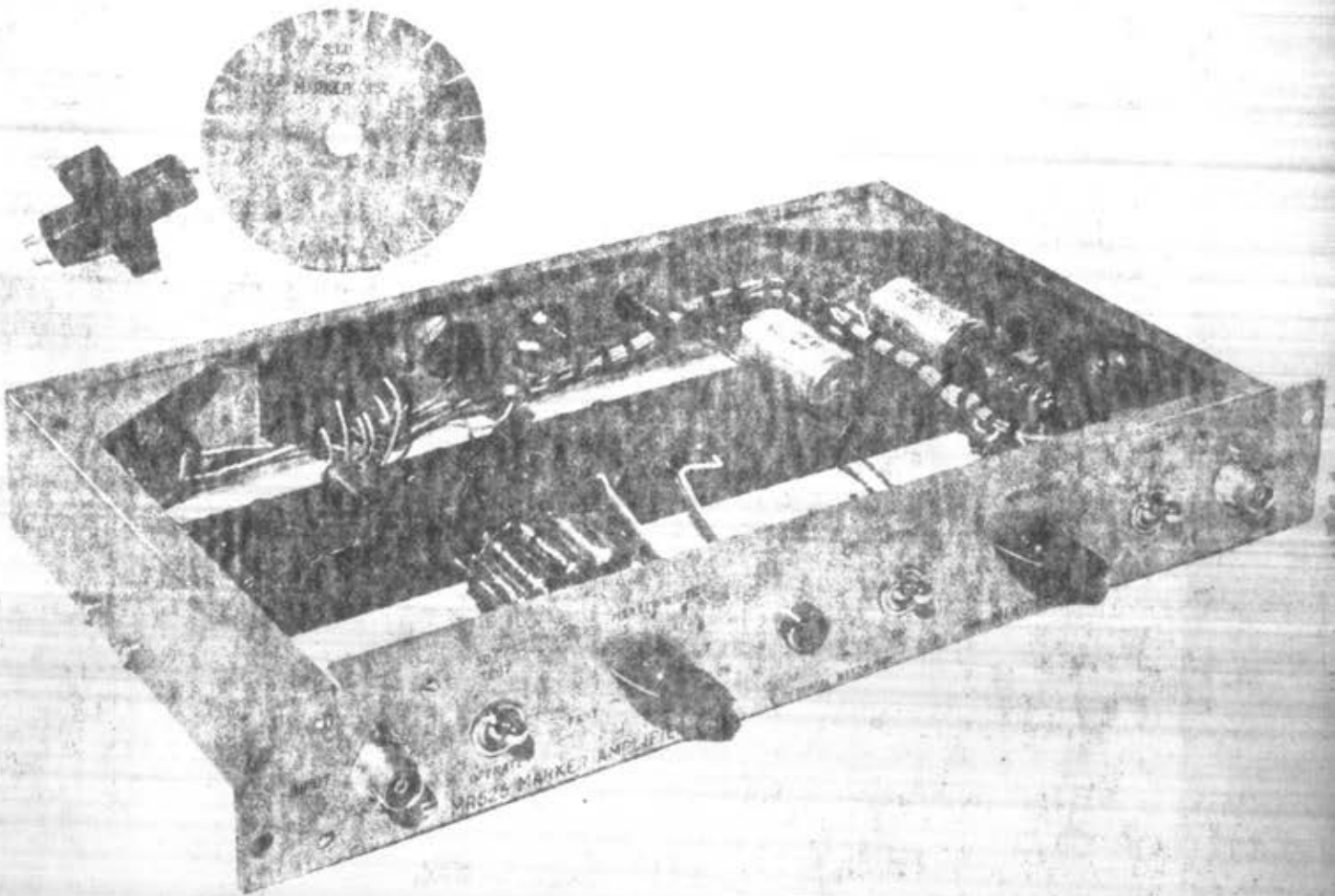


Fig. 3
MARKER AMPLIFIER type MR.525
with
Marker Dise type G.306
and
Magnetic Transducer type G.308

switchs and two controls regardless of the power-on switch. The first switch to the right of the input socket is the test-operate switch. In the absence of signal from the pick-up (ie. the engine is not running) this switch enables an output to be obtained to facilitate setting of the marker pulse height before a run is commenced. In the TEST position the INPUT socket is isolated and a mains frequency signal is applied internally to the amplifier input resulting in pulses at approximately 20 milli-second spacing on the oscilloscope screen when the OUTPUT socket is connected to the oscillography amplifier. The two controls are the marker width and amplitude control. The switch on the far right of the panel is the polarity switch which enables the operator to deflect marker pulses upwards or downwards at will.

Universal Oscillograph Recording Camera

The case is an aluminium casting that contains a continuous-feed attachment which provides continuous recordings of successive pressura variation from cycle to cycle of the engine to be recorded. This is done by switching off the time base of the oscilloscope, thus making the spot on the screen to move vertically in accordance with the signal from the charge amplifier,

and allowing the photographic paper to be driven pass the exposure gate of the camera at a very high speed. In this way a very fast moving of the spot can be shown on the paper after it is developed. The result is the trace of signal on a lengh of paper. The speed range of the paper range from 4 to 100 inches per second. This very high speed is obtained by altering the armature voltage of the driving motor and using gear reduction on the motor unit. The time of exposure is controlled by the opening of a simple sliding shutter, loading and unloading the camera are done by the use of black cloth sleeves on the top of the case. The rig of the recording camera is shown in Fig.4.

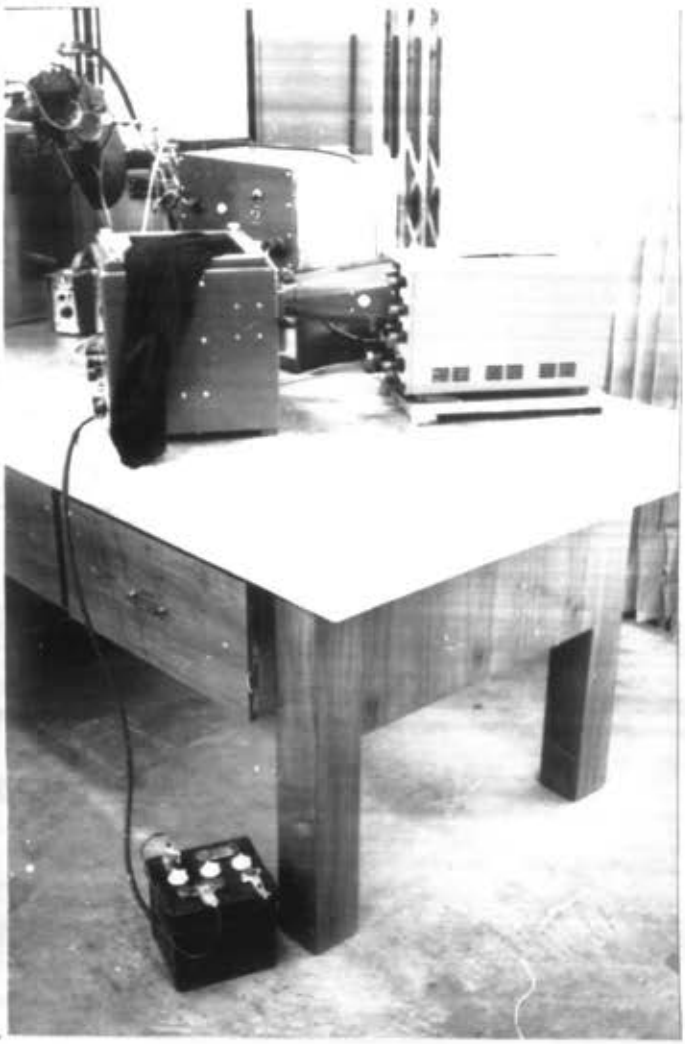
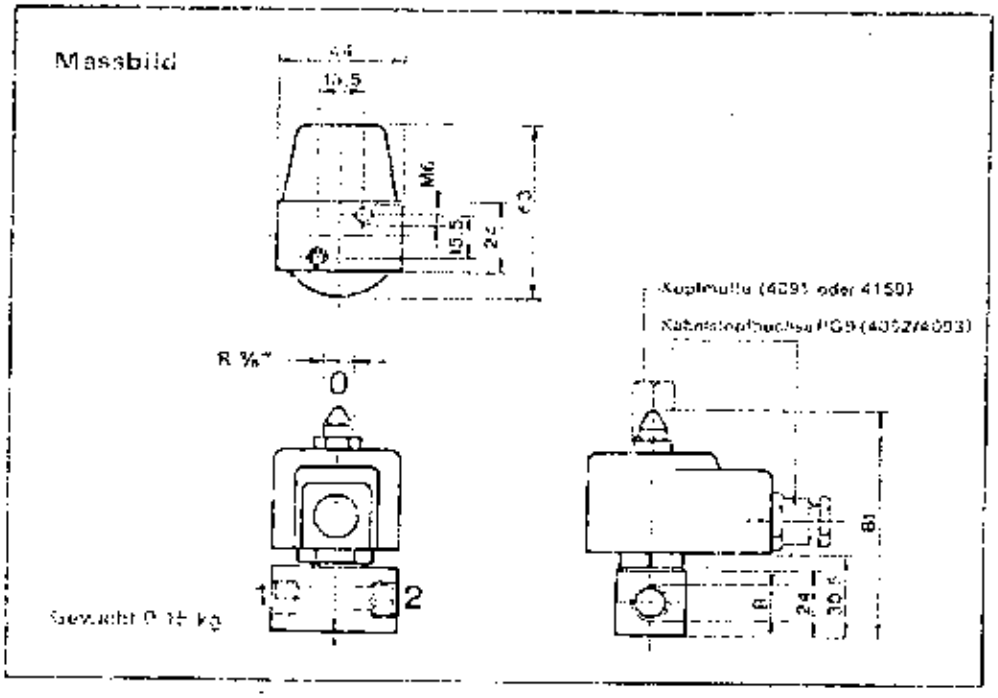


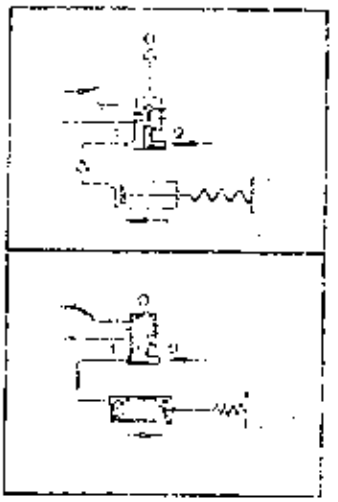
Fig. 4

Oscillograph Recording Camera Rig

Pressure Transducers and Adaptors

Two types of pressure transducer were used in the experiment. The Kistler 701 transducer was used to get the required traces of pressure variation in the exhaust system. It is mounted in the 737 two-way adapter which is provided with a pneumatically operated change over valves. This valve connects the transducer to the pressure in the port when compressed air is applied into the transducer. The air pushes the piston valve of a very small stroke, thus opens the transducer to the pulsating pressure to be recorded. As the air is released the spring pushes the piston valve back, hence connects the transducer to the atmosphere while doing so. The applying and releasing of the compressed air are done by energized and deenergized a three way solenoid valve which is operated by a sliding switch. Such a valve is shown in Fig.5 with one view in section. In acual use the valve was energized by two lead accumulators connected in series and giving 24 volts at terminal. The layout is shown in Fig. 6. Compressed air of about 150 psi was supplied, the pressure was reduced by a governer to 70 psi before entering the three-way solenoid valve at bottom right.





Art.-Nr.	⌀ mm	qn/U	R
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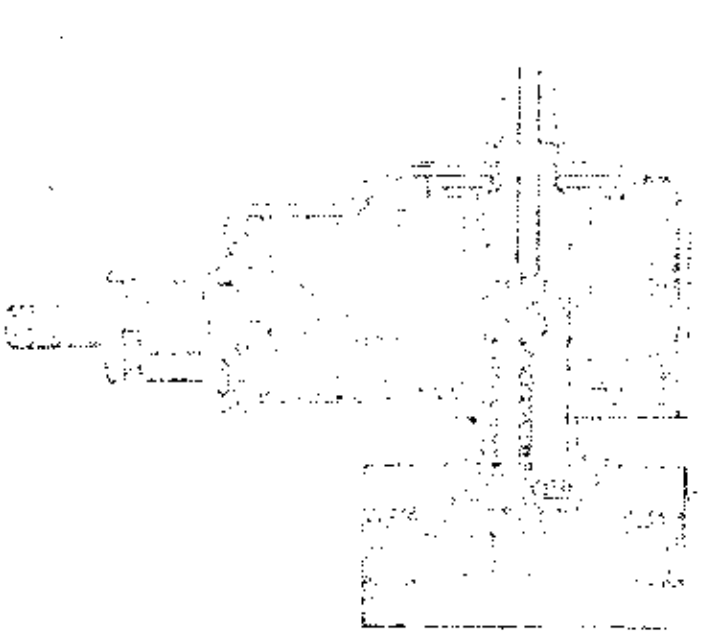


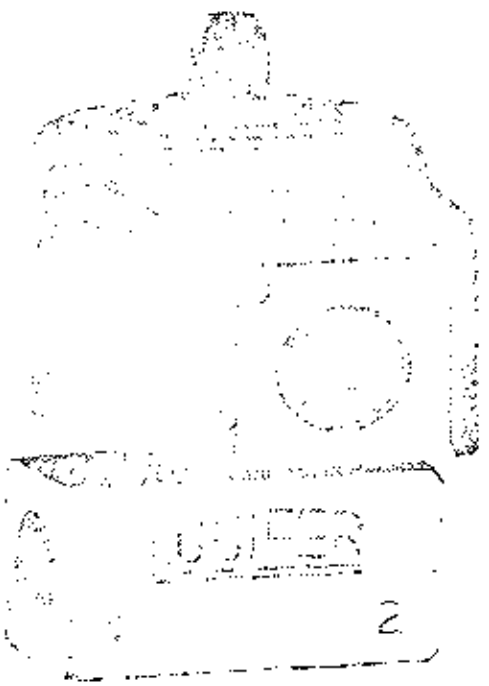


Fig. 5

Type 146 = 24 Va

Three-way Solenoid Valves

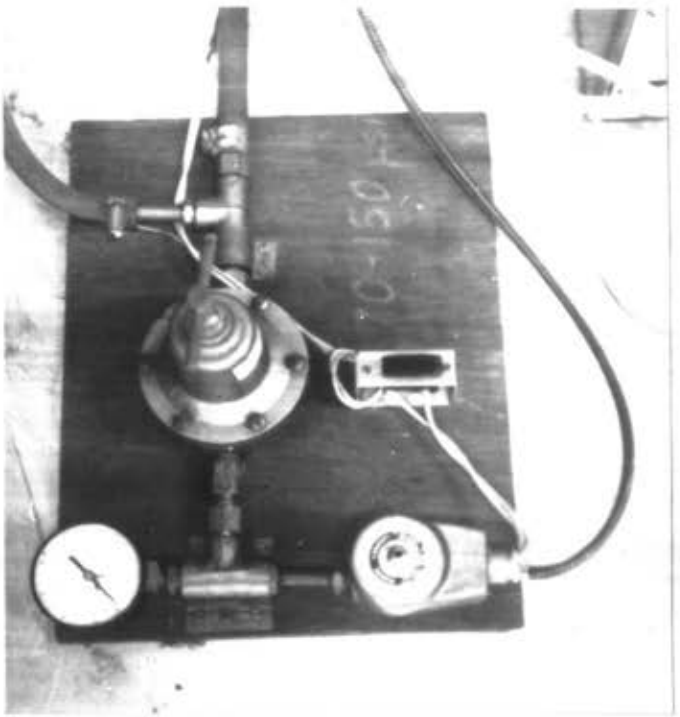
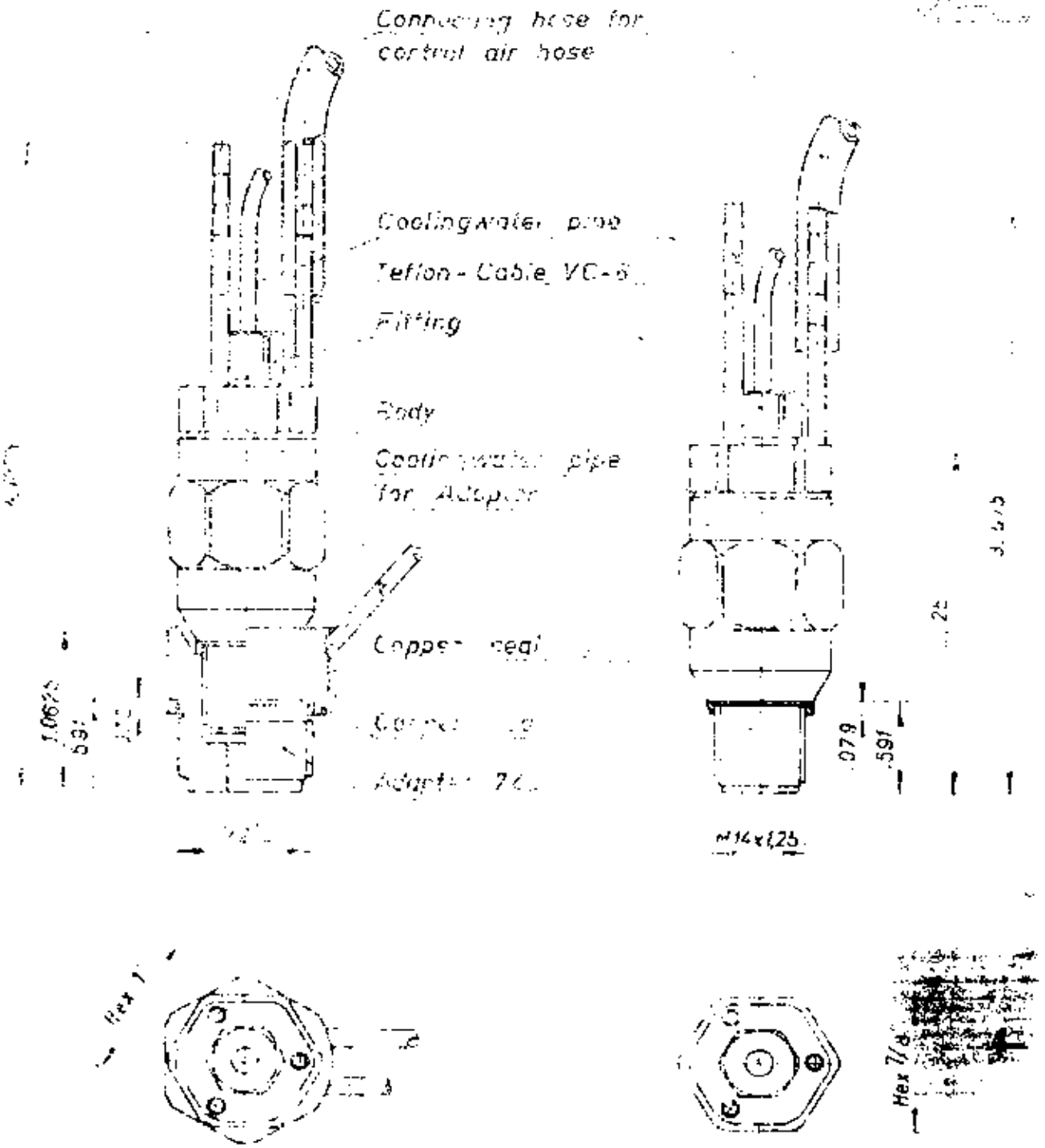


Fig. 6

Compressed-air Controlling Unit

The two way adaptor is also provided with a cooling water passage, but because of the high temperature of the exhaust gas it is assembled on the 740 water cooled adaptor. The water leaving the two way adaptor is fed to the 740 water cooled adaptor and then discharged. The two way adaptor is shown being assembled with the water cooled adaptor in Fig. 7 and the two adaptors are shown in section in Fig. 8.
By the explained principle the two way transducer was used to record the pressure pulsation in exhaust systems as well as the corresponding atmospheric reference line. In order to make the switching from one exhaust system to the other a convenient job, the adaptors were mounted on a tee fitting which was screwed to a coupling fitted on the exhaust port opening by means of a union. The exhaust pipe or the expansion chamber was then screwed to the other end of the tee. Such a connection is shown in Fig. 9.

To measure the pressure change in the crankcase the Kistler 601 transducer mounted in the 622 needle adaptor was used. The needle adaptor was screwed into a tapping of a 3 millimetre bore which was drilled into the crankcase. The assembly of the transducer and adaptor is show in section in Fig. 10 and the



Two way Adapter 737

Two way Adapter 737

Fig. 7

Two-way Adaptor

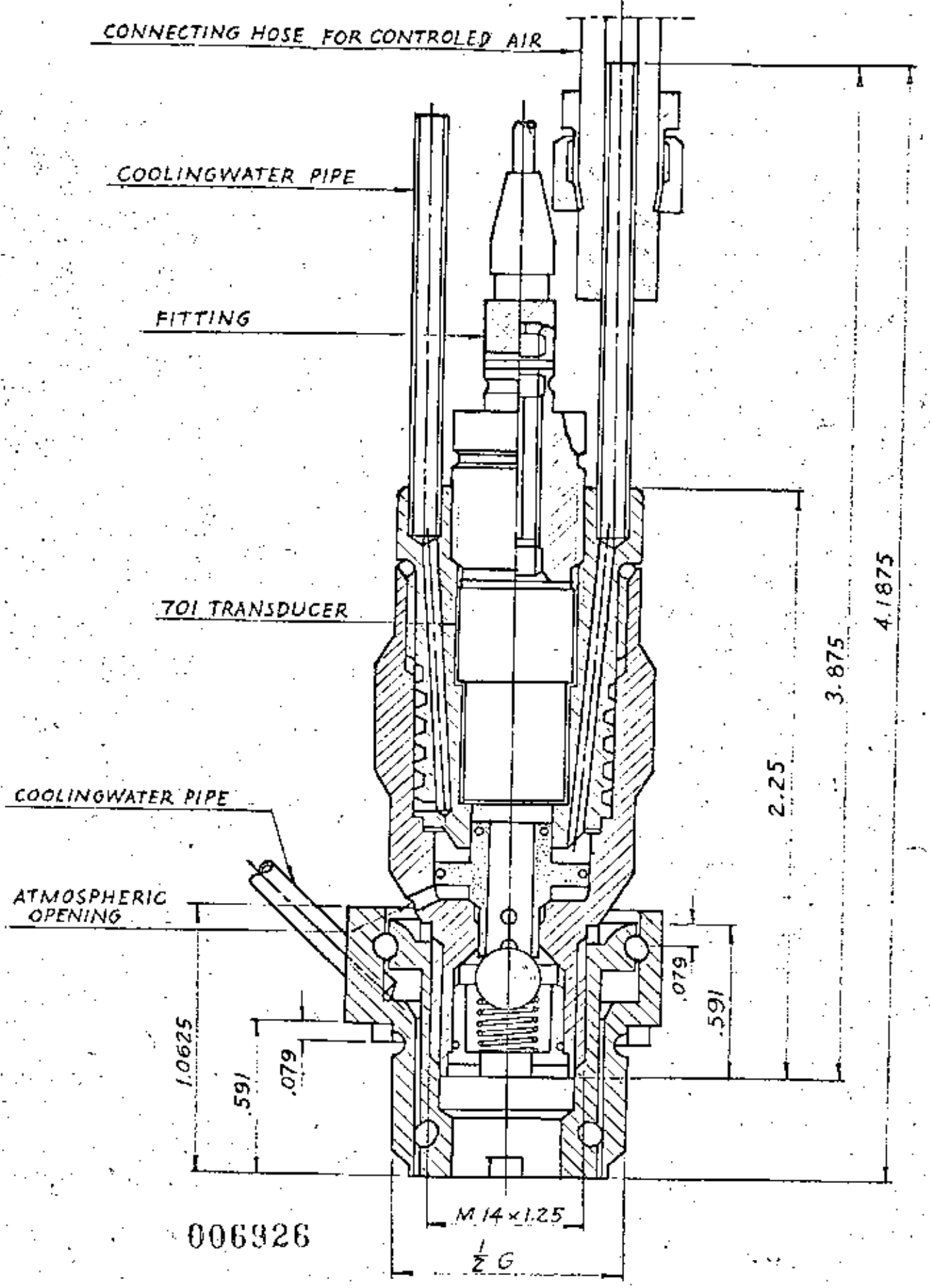


Fig 8. TWO WAY ADAPTER 737
WITH WATERCOOLED ADAPTER 740

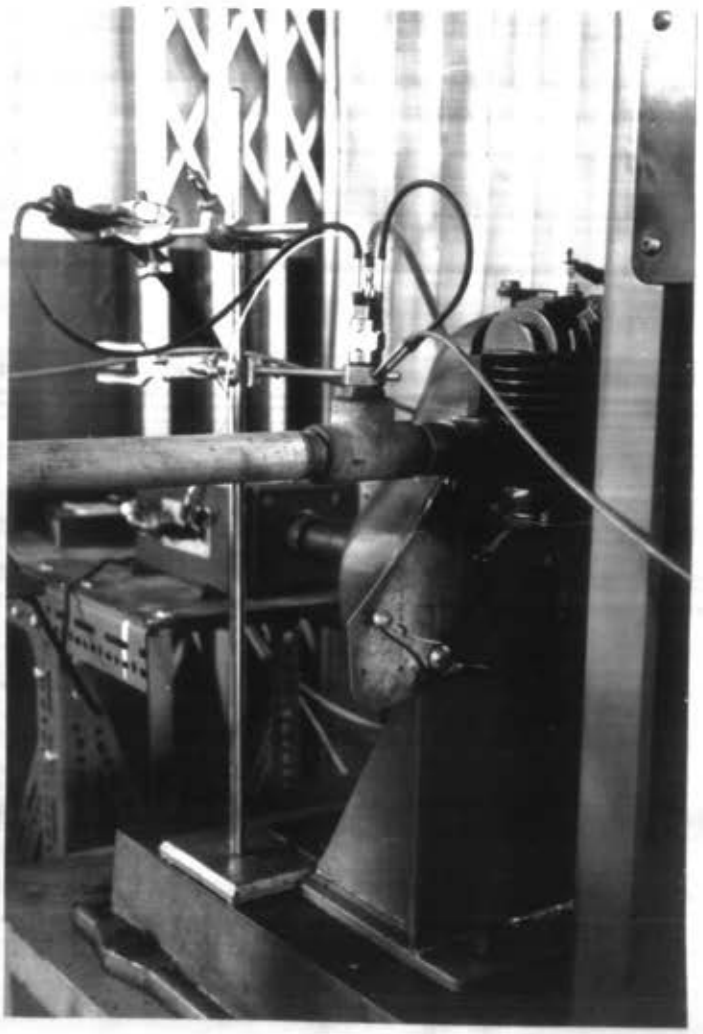


Fig. 9

Installation of Two-way Watercooled Adaptor on Exhaust Syaten

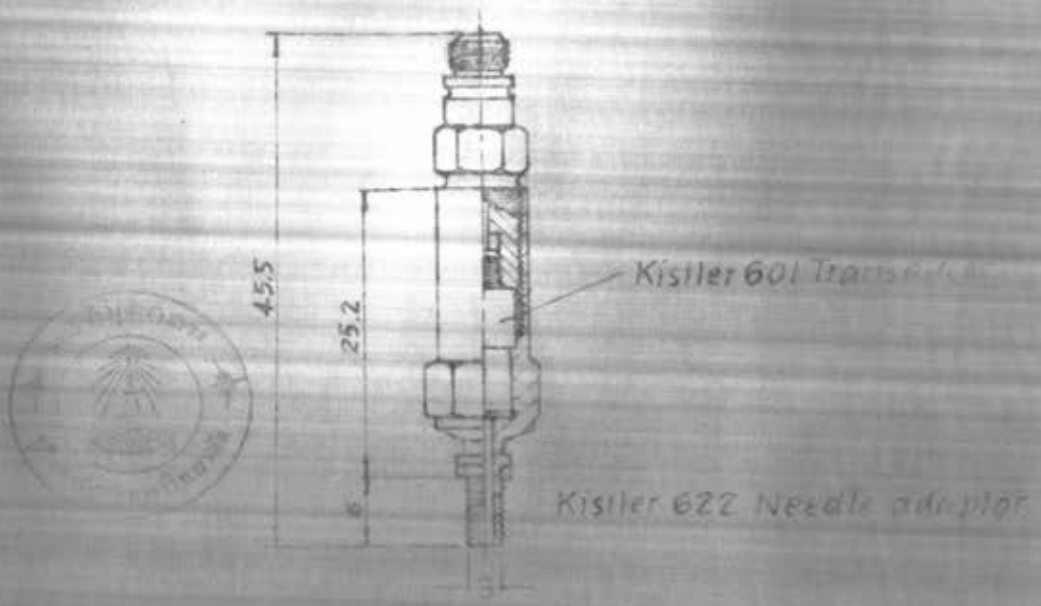


Fig. 10

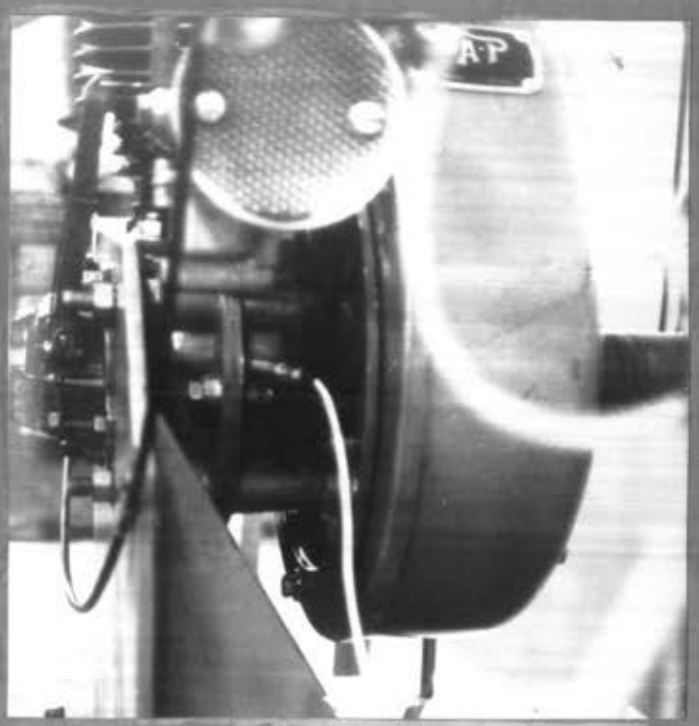


Fig. 11

Mounting of Needle Adaptor on the Crankcase

mounting of the needle adaptor is shown in Fig. 11.

The variation of pressure in the combustion chamber was measured by mounting the 622 needle adaptor to the ring adaptor. The ring adaptor was fitted to a long reached spark-plug on which a modification was made. The threaded part of the plug was shaped to make a canal of 2 mm. wide and the depth from the root of the thread was 1 mm. This left a gas passage of about 0.02 sq.cm. which was adequate for letting the gas flow freely. The gas from the combustion chamber could travel through the passage into the ring and along the small tube screwed to the ring which in turn accommodated the needle adaptor. Fig. 12 shows the picture of the set as being fitted to the engine and the sectional view of the ring adaptor as being assembled with the spark plug and the 622 needle adaptor is shown in Fig. 13.

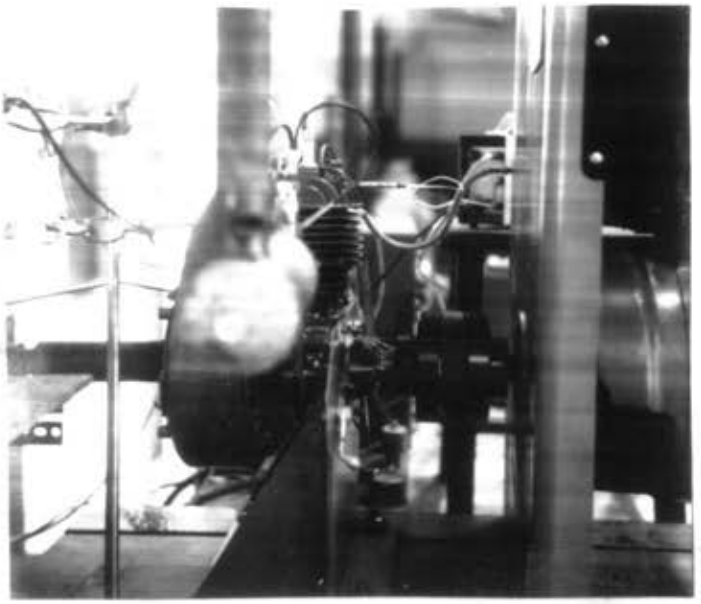


Fig. 12

Needle Adaptor with Ring Adaptor

Mounted on Cylinder Head

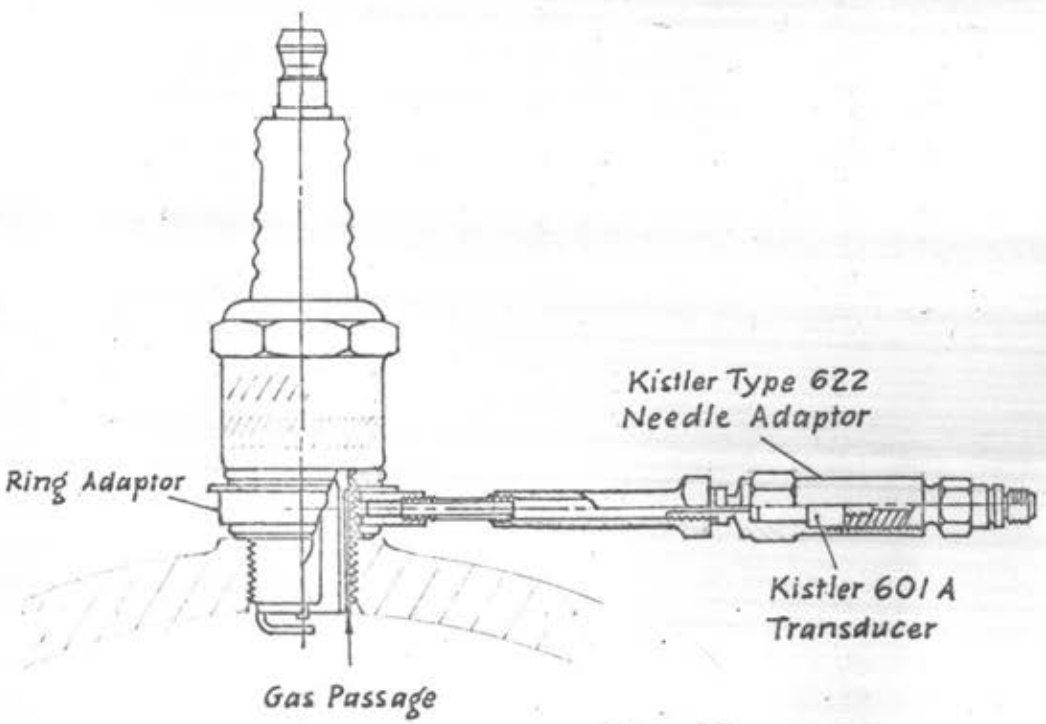


Fig. 13

Adaptor for Measuring Cylinder Pressure

Fitted on Spark-plug