forms are known as plate modulation systems, but there is also the grid system, which is, however, not widely used. In this, variations in the bias on the grid of the oscillator tube are caused by speech through a microphone, thus correspondingly fluctuating the plate current and causing modulation.

The percentage of modulation of a transmitter is the percentage that the modulation strength is of the carrier strength, as heard in a receiver. In other words it is the variation in the amplitude of the wave, caused by modulation, as compared with the amplitude of the carrier wave.

It follows that a carrier wave may also be modulated by using an alternating or pulsating direct current power supply to the oscillator valve, since the input is rapidly changed with the alternating voltage, with similar fluctuations in the output. This modulation evolves in a harsh, chopped-up signal, which is hard to read on Morse, and the voltage variation of the input creates much interference by causing the frequency of the wave to vary, and side-band frequencies to be set up. That is why pure direct current power supply is necessary for an oscillator to give a smooth, musical signal of a single frequency, and questions upon this subject are often set in the examination, e.g., "What are the disadvantages of using A.C. power supply to a transmitter?" or "What is the best type of current for supply to a transmitter, and why?"

Measurement of Frequency.

IT is advisable to know something about the frequency measurement, a common question being: "How would you measure the frequency of a transmitter by means of an absorption wavemeter?" The two chief types of wavemeters for this purpose are the heterodyne and the absorption types, the former being explained in the "Listeners' Guide." The absorption wavemeter, shown in Fig. II, consists of a coil tuned by a calibrated variable condenser, with a torch bulb in the circuit. When the meter is placed near the transmitter, the coil absorbs the greatest amount of r.f. energy when the two circuits are in resonance, or tuned to the same wavelength. This energy absorbed causes the bulb to light up, so that if the condenser is adjusted until the bulb lights up most, the wavemeter and transmitter are tuned to the same wavelength, which is shown on the calibrated condenser scale.

A frequent question is: "Describe two meters for the measurement of radio-frequency current." Such meters measure by the heating effect of the r.f. current, and the types are the hot-wire meter, described in the "Guide," and the thermo-couple meter. The latter (Fig. III) makes use of the principle that when two dissimilar metals are heated an E.M.F. is produced between them. The current to be measured is run through a small resistance AB, which heats a junction, C, of two such dissimilar metals, D and E, and the resultant E.M.F. is taken to an ordinary moving-coil meter which shows a reading dependant on the heat produced by the R.F. current.

Besides such questions as already mentioned, there are usually two or three on the elementary electrical principles, which are in the "Guide," or

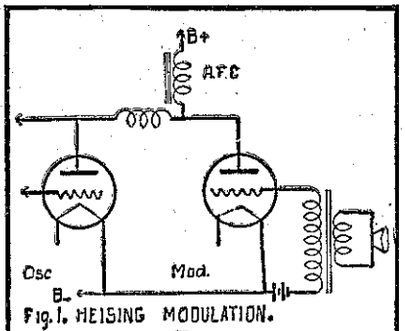

Fig.1. HEISING MODULATION.

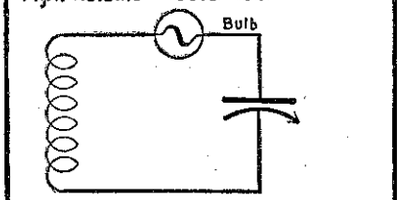

Fig.2. ABSORPTION WAVEMETER.

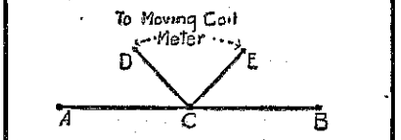

Fig.3. THERMO-COUPLE AMMETER.

have appeared in the "Record." They may be on Ohm's Law, calculation of resistances and capacities, in series and parallel, voltage drop through resistances, magnetic fields of bar magnets, inductance, and the fundamental theory of valves. They are all quite simple, highly technical answers not being required.

Amateur Radio Regulations.

The only remaining part of the exam. is that on the Amateur Radio Regulations. Though this is important, it is the easiest part, for it is simply a matter of learning the few laws given below, which constitute the chief regulations.

Firstly, there are the wavebands on which amateurs are allowed to transmit. They are as follow:—

Kilocycles.		Metres.
1715 to 2000	=	150 to 175
3500 to 4000	=	75 to 85.7
7000 to 7300	=	41.1 to 42.9
14000 to 14400	=	20.83 to 21.43
28000 to 30000	=	10 to 10.71

Special permission is required to operate on the bands below 80 metres, the latter being the only band in which telephony is allowed, in New Zealand.

An amateur must execute the usual declaration of secrecy, and must not commit to writing any public correspondence he may hear. If he should hear a distress signal (SOS) and has reason to believe it has not been intercepted by a ship or shore station, he must take steps to advise the nearest Government station, or, failing this, a responsible P. and T. officer. Amateurs must be able to recognise the interference warning signal sent by a Government station, AAAAQRM (here following a number indicating minutes) and must close down for the number of minutes indicated. The use of waves other than continuous waves, such as damped waves (spark transmission), is prohibited for amateurs, and all transmitters must be inductively coupled to the antenna.

Power supply to the transmitter must not be alternating current, and the transmitter should be adjusted and tuned at such times as to cause a minimum of interference. A log record, showing the hours during which the station is in operation, and a note of any special signal received, must be kept, while the station must not be used in any way to send or receive messages calculated to cause a loss of revenue to the P. and T. Department. The operator shall not transmit anything of a seditious, profane, obscene, libellous or offensive nature, or any communication of a false or misleading character, in particular a false SOS signal. All stations shall be open to inspection by a radio inspector, and the station license must be displayed in a prominent position.

Examples of questions on these regulations are: "What are the amateur bands in metres and kilocycles, and what are their conditions of use?" or "What are the classes of matter an amateur is not allowed to transmit?"; or "If you heard an SOS signal and had reason to believe it had not been intercepted, what steps would you take?"

Finally, the fee for sitting the examination is five shillings, and an application form may be obtained through a post office. Should any further information pertaining to the examination be required it will be supplied on application addressed to the writer at the "Record" office. In the next article there will be a description and discussion of a low-powered transmitter suitable for the beginner.

A Radio-equipped Railway Coach

For Use in Emergencies

THE recent earthquake in Southern Italy caused considerable attention to be drawn to the wireless coach of the Italian State Railways. This is a special eight-wheel coach, which comprises not only a complete telegraph and telephone equipment but also a wireless installation consisting of three transmitters and three receivers.

This coach was specially built and equipped with radio for the purpose of being placed at railways points in or near zones which have been disturbed by events such as earthquakes, inundations, lava eruptions, and so on. At such places it is essential to re-establish telegraphic and telephonic communications, which, as a rule, are interrupted, with a view to maintaining contact with the central authorities.

The wireless equipment has been provided for use in those cases where the telegraph or telephone lines have been destroyed or otherwise put out of working order over a large zone near the railway. The apparatus provided comprises three transmitters and three receivers. One complete station (transmitter and receiver) remains permanently in position in the coach, while the other two form separate flying stations, which can be transported considerable distances and still keep in touch with the coach station.

The fixed transmitter is a 50-watt short-wave set, while the receiver covers a range of wavelengths of from 12 to 100 metres. Both transmitter and receiver utilise the metallic frame of the carriage and permanent way rails as an earth, the aerial being supported on two telescopic lattice masts about 20 feet in height and 40 feet apart. These masts are hinged so that they can be placed horizontally along the roof when the coach is travelling.

The two flying stations are similarly equipped, except that the aerial of each is supported by a tower about 30 feet high. To the top of this is attached one end of the aerial wire, while the other end is usually attached to a tree or convenient high point. The counterpoise, in the form of a wire, is generally stretched out on the ground. The power supply is obtained from light motor-generator sets.

Fortunately, since it has been available the wireless coach has had no call to duty until the recent disaster—in the form of an earthquake—which befell Southern Italy. The coach was then sent, attached to a first-aid train, to the affected zone, and was placed at a station which formed the junction of four mountain railway lines. There, in conjunction with the two flying stations, which were disposed more to the south, it did excellent work, communicating successfully with the central authorities as far north as Rome, a distance of about 200 miles.