frequency. The reflector is placed parallel to the first dipole at a distance of $\frac{\lambda}{8}$ to $\frac{\lambda}{4}$ behind it, looking from the direction of the desired transmission source. The effect of the reflector is also to suppress reception from sources behind the main aerial, the directional diagram being heart shaped with maximum pick up at right angles to, and in front of the first dipole. If the reflector is of different physical or electrical length (this is effected by inductance or capacitance at its centre) compared with the main aerial, a more constant response [20] can often be realized over a given frequency range.

3.3.6. The Frame Aerial. The frame or closed loop aerial is an inefficient collector as compared with the normal open aerial, and its chief advantage is its directional property. It operates for vertically polarized transmission only when there is a phase difference between the voltages induced in the two vertical sides. These voltages are equal and cancel each other when the plane of the loop is parallel to the electrostatic component of the transmitted field and perpendicular to its direction of travel. When the frame is not perpendicular to the motion of the field, there is a phase difference between the voltages induced in the two limbs, that induced in the limb nearest the source of the wave leading on the voltage in the other limb. This means that at any given instant the voltages are unequal and there is a net voltage to drive current round the loop. The phase angle between the two voltages is the distance in radians between the projections of the two vertical limbs on to a plane parallel to the motion of the wave. If λ is the wavelength of the desired signal, b the breadth of the frame and α the angle between the plane of the frame and the motion of the wave (Fig. 3.7a), the phase angle is $\frac{2\pi}{\lambda}b\cos\alpha$. The phase angle is clearly a maximum when α is 0, i.e., when the frame is parallel to the motion of the wave, and in this position the pick-up is maximum. The maximum effective voltage induced in the frame is $nEh\sin\frac{2\pi b}{\lambda}$ where n is the number of turns in the frame, E is the field strength of the signal at the frame and h is the length of a vertical side. When $\frac{2\pi b}{\lambda}$ is small the induced voltage is

$$\frac{nEh2\pi b}{\lambda} = \frac{2\pi nE}{\lambda} \times \text{area of frame} \qquad . \qquad . \quad 3.16.$$

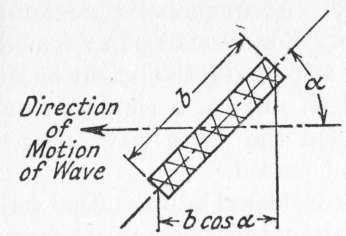

Fig. 3.7.a—Plan View of a Frame Aerial.

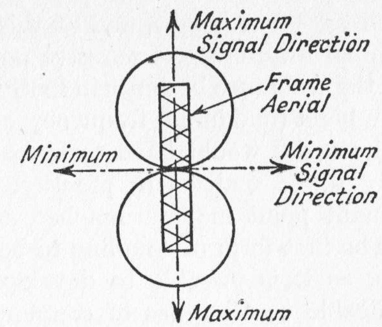

Fig. 3.7b.—The Directional Diagram of a Frame Aerial.

The directional diagram of the frame is a figure-of-eight with minimum from directions at right angles on either side of the frame and maximum from the two end-on positions (Fig. 3.7b).

3.4. The Coupling between the Aerial and Receiver.[3, 17]

3.4.1. Introduction. An aerial may be coupled to the first tuned circuit of a receiver by inductance and capacitance, separately or combined. Owing to this coupling, a resistance and reactance component is reflected from the aerial into the tuned circuit; this reduces its selectivity and also requires the tuning capacitor setting to be changed if resonance is to be maintained, a disadvantage when the circuit is ganged with succeeding tuned circuits. The object of the coupling is therefore to obtain maximum voltage transfer with minimum effect on the tuned circuit. For any given aerial and tuned circuit conditions, there is always an optimum coupling giving greatest voltage transfer, and if coupling is increased beyond this point voltage transfer falls and the reflected impedance effect from the aerial increases. Hence it is most undesirable to exceed optimum coupling, and indeed it is preferable to use couplings much less than critical since voltage transfer falls at a much slower rate than the reflected aerial impedance. For couplings less than optimum, maximum voltage transfer is realised by adjusting the tuning capacitance for resonance with the tuning coil and added reactance from the aerial.

In the analysis, which follows, the aerial circuit is assumed to consist of a generator of voltage E_1 with an internal impedance equal to the terminal impedance Z_{a0} of the aerial. This impedance is considered as a resistance R_{a0} in series with a reactance jX_{a0}; for most normal aerials the reactance is capacitive on the long and medium wave bands. The fundamental wavelength of an aerial is