

MAGNETIC  
RECORDING

WIRE AND TAPE

M. L. Quartermaine

NORMAN PRICE (PUBLISHERS) LTD.  
283 CITY ROAD :: LONDON, E.C.1

N. H. CROWHURST, A.M.I.E.E., *General Editor*

First published May, 1952  
Second edition September, 1952

Printed in Great Britain by Thomasons Ltd., Cedar Press, Hounslow

## CONTENTS

1. GENERAL THEORY	page 9
2. MECHANICAL LAYOUT AND CONSTRUCTION (TAPE)	21
3. AMPLIFIERS	30
4. HEAD CONSTRUCTION	47
5. OPERATION AND ADJUSTMENTS	54
6. WIRE RECORDER	56
7. USING A RECORDER	68

## ILLUSTRATIONS

FIGURE	PAGE
1. Magnetizing characteristic of typical material, showing hysteresis loop	10
2. Remanent induction plotted against magnetizing force, showing the non-linearity of the transfer characteristic	11
3. Showing how a.c. bias enables distortionless recordings to be made	12
4. Playback head output plotted against recording bias current for a typical medium	13
5. Showing how a recording head produces the magnetizing force in the recording medium	14
6. Typical head arrangement	14
7. Diagrammatic representation of a magnetic medium with notes of different frequencies recorded on it	15
8. Lines of force between pole pieces giving an effective gap $3/2$ times the physical gap "g"	16
9. Increase of effective gap when the medium is not in close contact with the pole pieces	16
10. Playback not aligned with recording gap	17
11. Frequency response for record and playback on a typical medium	17
12. Erasing by use of a series of permanent magnets of decreasing strength	18
13. Various drive arrangements	18
14. Basic arrangement of simple type of wire recorder	19
15. How to lay out the drive motor and playback head for minimum hum pick-up	22
16. Layout of components on the motor board of typical tape recorder	23
17. Main dimensions of capstan	24
18. Pinch wheel assembly and spring catch	25
19. Shape of spring catch before bending	25
20. Tape-up spindle and pulley construction	26
21. Feed and rewind spindle construction	27
22. Dimensions of tape guide	27
23. Tape guide mounted on motor board	27
24. Brake and jockey pulley operating mechanism construction	28
25. Block diagram of complete erasing, recording and playback operations	30
26. Block diagram of a simplified erase, record, playback system, using switching	31
27. Record/playback frequency characteristic of high and low coercivity tapes	31
28. Playback amplifier circuit	32
29. Bass lift circuit and equivalent values in terms of actual circuit components	33
30. Bass lift response characteristic	33
31. Circuit of recording amplifier	34
32. Top lift response characteristic at different settings	35
33. Combined record/playback amplifier with switching	35
34. Circuit of bias oscillator	36
35. Advanced bias oscillator, to give improved waveform	37
36. Power pack circuit	38
37. Complete circuit for record/playback amplifier equipment. I	39
38. Advanced record/playback amplifier circuit. II	40
39. Block diagram of equipment using three separate heads	41
40. Recommended layout for Amplifier I	41
41. Directions of strong and weak field radiation and pick-up of transformers	42
42. Showing the three basic ways of mounting a transformer on a chassis	42
43. Suggested disposition of contacts on play/record switch for amplifier I, to avoid undesired transfer	43

ILLUSTRATIONS (continued)

FIGURE	PAGE
44. Motor switching circuits	46
45. Typical commercial head lamination shapes	47
46. Cross sections of a completed head	48
47. Method of cutting standard "U" or "E" laminations	48
48. Temporary clamp for grinding laminations	49
49. Showing the procedure for winding coils on laminations	49
50. Clamp dimensions for No. 187 (M. & E.A.) laminations	50
51. Aligning the laminations prior to clamping	51
52. Grinding the front face of the head	52
53. Construction of the head screen	52
54. Complete head assembled	53
55. Showing the gap correctly located in the centre of the tape contact area	54
56. Plan of high quality wire recorder	56
57. Wire guide	57
58. Pinch wheel and capstan layout for 78 and 1,400 r.p.m. drives	57
59. Take-up spindle and pulley for wire recorder	58
60. Method of operating brakes for wire recorder	59
61. Two methods of providing to and fro motion for operating the wire laying arm	59
62. Arrangement of wire laying mechanism	60
63. The derivation of cam shape	61
64. Blank from which cam is made	61
65. Set-up for marking out the blank	62
66. Marking out the blank	62
67. Wire head using cut down .005 in. laminations to provide a slot	63
68. Wire head using two filed down .015 in. laminations	63
69. Constructional details for wire spool	65
70. Arrangement of wire laying mechanism for semi-constant speed wire recorder	66
71. Construction of a bracket to carry mechanism of Fig. 70	66
72. Brake block for simple wire recorder	66
73. Showing directional sensitivity and polar diagram of velocity (ribbon) type microphone	68

1

GENERAL THEORY

**I**N this chapter it is intended to describe very shortly the basic theory of magnetic recording and to give a background for the more practical designs given later.

Firstly, it must be explained that in spite of Poulsen's historic achievements at the beginning of this century, magnetic recording is an extremely young science and has only been made practicable for the home constructor in the last year or so. To a large extent, the reason is that there was no suitable recording medium available outside laboratories. Now it is possible to get wire and coated tape from a number of manufacturers.

There are two main types of medium. Fine magnetic wire .004 ins. in diameter; and a plastic (or paper) tape  $\frac{1}{4}$  in. wide and coated with either the red (Fe<sub>2</sub>O<sub>3</sub>) or black (Fe<sub>3</sub>O<sub>4</sub>) oxides of iron. Other mediums such as coated paper discs and tubes or steel tape are in use, but are neither suitable for nor available to the experimenter.

The advantages and disadvantages of tape and wire are greatly argued, but the main points are as follows:

WIRE

Cost per hour	40s.
Output on playback	Fairly high
Bulk per hour	$\frac{5}{8}$ ins. x $2\frac{7}{8}$ ins. diameter wide spool
Mechanical handling	Slightly complicated
Ease of editing	Difficult
Speed of playing	24 ins. per sec.

TAPE

Cost per hour	35s. at double track
Output on playback	Low
Bulk per hour	$\frac{3}{8}$ ins. wide x 7 ins. diameter reel at double track
Mechanical handling	Simple
Speed of playing	7 $\frac{1}{2}$ ins. per sec.

The above speeds of playing are comparable and are suitable for high quality music, other standard speeds for tape are 3 $\frac{1}{2}$  ins. per sec., 15 ins. per sec. and 30 ins. per sec. The first is usually used for recording speech and the last two for studio equipment.

Thus the wire scores on bulk per hour and output and the tape scores on the mechanical side, as it needs no mechanism to keep the layers wound evenly and can be handled and loaded with ease.

Now, knowing the materials at our disposal, a brief summary of the methods of recording and playing back with them is required.