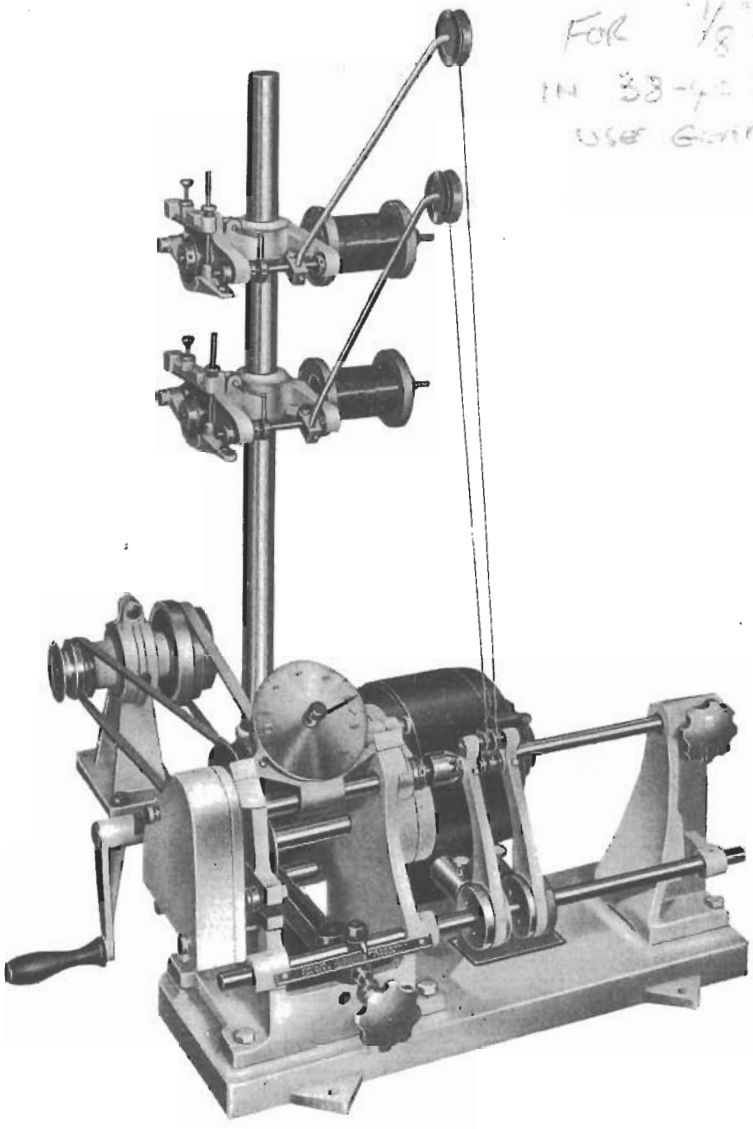
"DOUGLAS"

WAVE WINDER AND PROGRESSIVE WAVE WINDING MACHINES



INSTALLATION · OPERATION · MAINTENANCE

AND PARTS LIST

"DOUGLAS" WAVE WINDING MACHINES

MANUAL OF INSTALLATION, OPERATION AND MAINTENANCE

THIS Instruction and spare parts manual is intended to cover all types of "DOUGLAS" Wave Winder and Progressive Wave Winding Machines.

— INDEX —

LIST OF PLATES

THE "DOUGLAS" WAVE WINDER

All types of wave wound coils, as used in the Radio and allied industries, may be wound on the "DOUGLAS" Wave Winder, within the limits specified under the heading "WINDING CAPACITY". This Machine is highly efficient and setting up can be accomplished by an operator with comparatively little experience of this type of work. Coils having fractional or multiple waves can be wound simply by changing gears, changing of the cam is not necessary. An important feature of the Machine is that it can be hand operated or power driven, making it ideally suitable for Laboratory use or Mass Production.

WINDING CAPACITY

Coils of various wave forms from $\frac{3}{32}$" (2·4 mm.) to $1\frac{3}{4}$" (45 mm.) wide and up to 4" (102 mm.) diameter can be wound on this Machine.

RANGE OF WIRE

The range of wire the Machine will handle varies from 46 s.w.g. (0·0024"—0·05 mm.) to 20 s.w.g. (0·036"—0·9 mm.) and, to ensure perfect winding it is recommended that the wire shall be either silk, rayon or cotton covered. Litz wire can also be wound if the overall diameter is within the above range.

INSTALLING THE "DOUGLAS" WAVE WINDER

EQUIPMENT

When a "DOUGLAS" Wave Winder leaves the factory it is complete with two wire guide arms, allowing for two coils or pies to be wound simultaneously. There is, however, sufficient space for up to four such windings to be made at once; the additional wire guide arms and reel carriers may be obtained at extra cost.

The equipment supplied with each Machine includes:—

1. Two "DOUGLAS" Standard Reel Carriers with Stand.
2. One set of change gears, comprising nineteen change gears and eight wave change gears.
3. One $\frac{1}{4}$"—$\frac{5}{16}$" spanner for adjusting the gear quadrant.
4. Two small hexagon wrenches for the 0 B.A. and 4 B.A. grub screws.
5. One length of round leather belt (sufficient to make two driving belts).

Should it be decided to have the Machine power driven, the manufacturers recommend a $\frac{1}{4}$ h.p. motor having a speed of 1,425 r.p.m. and a "DOUGLAS" Countershaft; both these items usually being purchased from the manufacturers along with the Machine. An endless canvas belt is also supplied when the last two items are ordered, for driving the countershaft from the motor.

For Overseas users, when the speed of the motor is slightly more or less than 1,425 r.p.m., a special pulley is fitted to the "DOUGLAS" countershaft.

BENCH LAYOUT

When choosing a site for the Machine sufficient space should be allowed for a Soldering Iron, material and finished work. A rack should also be provided for the change gears and wrenches.

The Machine should be set out as shown on the Bench Lay Out Plan, see Plate No. 3, as this arrangement occupies the most economical bench space, and, furthermore, allows for belt slackness to be taken up by the eccentric in the countershaft.

The Machine should first be secured to the front of the bench with four $\frac{1}{4}$" (6 mm.) diameter bolts or stout wood screws. The "DOUGLAS" countershaft is then placed in position, as indicated on the Bench Lay Out Plan, and the leather belt passed around the pulleys on the Machine and countershaft, cut to the correct length, and fastened with a staple or similar fastener. The remaining length of belt will be found to be sufficient for making a drive from the countershaft to the cam on the Machine (see "DIRECTION OF ROTATION AND WINDING SPEEDS").

The position of the motor in relation to the countershaft is best determined by placing the canvas belt over the motor and countershaft pulleys. It is, of course, essential to see that all the pulleys are in perfect alignment before final fixings are made.

To comply with the suggested method of starting the Machine a 5 amp. ON/OFF switch for starting and stopping the motor should be secured to the bench at the right hand end of the Machine (see Plate No. 3).

DIRECTION OF ROTATION AND WINDING SPEEDS

The Headstock Spindle must rotate in an anti-clockwise direction when viewed from the Tailstock end of the Machine.

The winding speed of the Headstock Spindle depends entirely upon the type of coils to be wound, and should not exceed a maximum of, say, 800/850 r.p.m.

Using a motor, as recommended by the manufacturers, three spindle speeds of approximately 350, 450 and 700 r.p.m. are obtainable by changing the position of the belt on the three stepped motor and countershaft pulleys.

NOTE: These speeds are slightly affected by the ratio of the four-gear train, but since this is so small it can be ignored.

The speed of the oscillation of the wire guide arms must also be taken into account, as this is affected by the changing of the wave gears. Thus, when single or fractional wave gears are being used, the drive from the motor to the Machine must be on the machine pulley, whereas when multiple waves, i.e., 2, 3 or 4 crossings per turn, are being made, the drive must be on the cam, and in this case the belt must be crossed, or the direction of rotation of the motor reversed.

BEFORE STARTING

To facilitate packing the Machine for transit the Handle (Item No. 2, Plate No. 1) is reversed to its normal position and must be set correctly before the Machine is started.

All the protective Lanoline should be removed, and it is essential to see that all the oiling points are lubricated with a fine grade machine oil.

GUARDING MOVING PARTS

In accordance with Factory Regulations in force in the country where the Machines are being used, guards should be fitted over belts and other moving parts.

SETTING UP THE MACHINE

Whilst, of course, the design of wave wound coils is beyond the scope of this manual, it may be an advantage to mention one or two points before describing the set-up of the Machine.

(*a*) Narrow coils usually have lower distributed capacity than wide coils of the same inductance, and, therefore, when low distributed capacity is required, a small cam throw should be used.

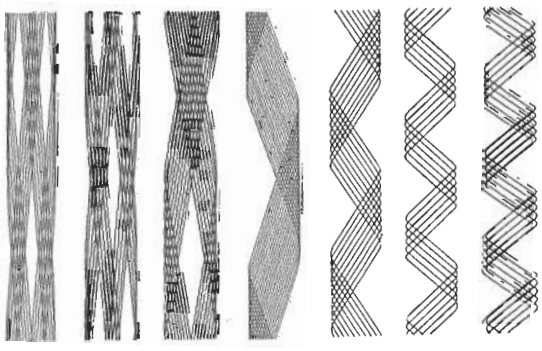
(*b*) A maximum electrical efficiency (Q value) is generally obtained when the whole winding is about square in cross section. This is true whether the coil consists of one or more pie windings.

(*c*) Multi-section coils are used when very low distributed capacity is desired.

The fundamentals of wave winding are the synchronism of a complete cam cycle with a revolution of the coil. If it is understood that a cam cycle is equivalent to the movement of the wire guide arm from a given point and back, it can be seen that to build up a pie winding the coil must rotate slightly more (progressive winding) or slightly less (retrogressive winding) than one revolution for a complete cam cycle. The wave form of a coil may be determined by the ratio of its mean diameter to its width. Where a coil is wide in comparison with its mean diameter a fractional wave should be used, whereas a multiple wave form should be used when the coil is narrow in relation to its mean diameter.

The term "wave" means the number of times the wire guide arm crosses the width of the coil in slightly more or less than one revolution. Thus, for single wave there are two crossings (one complete cam cycle), double wave four crossings (two complete cam cycles), and for fractional wave forms the coil rotates a multiple number of times for a complete cam cycle. For example: quarter wave, the coil makes slightly more or less than four revolutions in two crossings of the wire guide arm.

The wave change gears supplied with the "DOUGLAS" Wave Winder allow for quarter, third, half, single, double, treble and quadruple wave forms to be made; some examples are illustrated in the accompanying sketch.



EXAMPLES OF VARIOUS WAVE FORMS AROUND CIRCUMFERENCE OF COIL

SETTING UP THE MACHINE

Having decided upon the wave form to be used, the necessary gears may be selected and placed in position as shown on the gear chart (see Page 9). *NOTE:* The Wave Change Gears are the eight thick ones and no others should be used.

To determine the gear combination for the compound gear train on the extreme left hand end of the Machine, the overall diameter of the wire being used is measured with a micrometer. This reading is then multiplied by 1·2 and the result is substituted in the formula shown on Page 8. All the A, B, C, D gear combinations shown in the table give retrogressive windings, and to obtain progressive winding the combination must be completely reversed.

When the two gears on the Gear Quadrant are meshed with the two fixed gears, slight play should be allowed between the teeth, otherwise excessive wear will take place and the gears will be noisy. *NOTE:* The formula mentioned above remains the same when the metric system is used (see typical examples on Page 8).

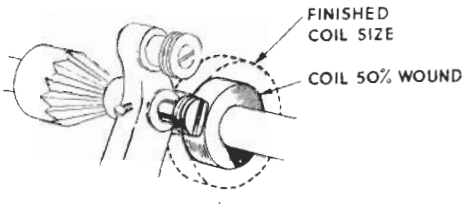
To set the winding width of the coil the Hand Wheel (Item 59, Plate No. 1) is turned in a clockwise or anti-clockwise direction. This alters the position of the Throw Adjusting Block (Item No. 51), for it will be seen that with this Block towards the front of the Throw Adjusting Screw (Item No. 57), the narrowest coil is wound, and at the back of the Throw Adjusting Screw the greatest width coil is produced. Having approximately positioned the Throw Adjusting Block, the Machine is operated by hand, and the number of divisions the Pointer (Item No. 65) crosses the Throw Indicator (Item No. 62) shows the width of winding, one division registering $\frac{1}{8}$" (3·2 mm.). The Throw Indicator gives fairly accurate reading up to widths of $\frac{5}{8}$" (15·9 mm.) (five divisions) but final checking may be made by measuring the two extremes of the throw of the Wire Guide Arm Spindle (Item No. 50). The only other settings to be made apply to Wire Guide Arms and Revolution Counter (see separate headings).

When all the settings have been made and the Machine is power driven, it is recommended that the Handle should be used to start the Machine revolving, and, having attained a good speed, the power is then switched on. The Handle is provided with a special slipping dog clutch and thus no harm can come to the operator when this is being carried out.

WIRE GUIDE ARMS

The Wire Guide Arms fitted to the "DOUGLAS" Wave Winder (one of which is illustrated on Plate No. 2) may be made right or left handed by changing the position of the Wire Guide Pulley and Guide Button (Items 15 and 13). The standard Guide Button allows for pie windings to be made at $\frac{7}{32}$" (0·218"—5·5 mm.) spacings.

Special Guide Buttons, if required, may be obtained from the manufacturers. The position of the Guide Button plays an important part in the laying of the turns of wire, and when a new winding is set up it should be positioned as shown in the accompanying sketch. It will be seen that the centre of the flat is in contact with the coil at the 50% wound position.



Further adjustment, if necessary, may be carried out by loosening the Screw (Item No. 13) and slightly altering the angle of the Button. *NOTE:* If a good winding is not being produced, the left hand gear combination should not be changed until it has been ascertained that the trouble is not due to the Guide Button.

To change the position of the Wire Guide Arm, the Screw (Item No. 9) is loosened with the largest hexagon wrench provided and the Arm is moved along the Wire Guide Arm Spindle (Item No. 50, Plate No. 1) to the desired position. Care must be taken to tighten the Screw after adjustment of the Arm. If for any reason this Screw is removed, it is important to see that the special Grub Screw (Item No. 8) is not lost. This special screw does not need adjusting and should not be tampered with. It is fitted to avoid damage to the Wire Guide Arm Spindle (Item No. 50) that may be caused by Screw (Item No. 9).

The Weight (Item No. 5) may be removed from the Stud or pushed as near to the Arm as possible, when small coils up to, say, 1·5" (38 mm.) diameter are being wound. From experience it has been found that the Weight is only necessary when a coil has an initial or final diameter that would tend to make the Arm fall away from the coil.

REVOLUTION COUNTER

The Revolution Counter fitted to the "DOUGLAS" Wave Winder, shown on Plate No. 2, is driven by a Worm Thread cut in the Headstock Spindle, and will record up to 2,000 turns.

Before winding is commenced, and with the Pointer (Item No. 17) at about 150 on the Large Dial (Item No. 1), the Small Dial (Item No. 4) is turned until 1,800 can be seen in the aperture. The Pointer is then moved round to 200 on the Large Dial, and it will be observed that the moment the Machine is rotated the Small Dial returns to zero, hence an exact number of turns wound on to the coil can be recorded by the addition of the readings on both Dials.

REEL CARRIERS

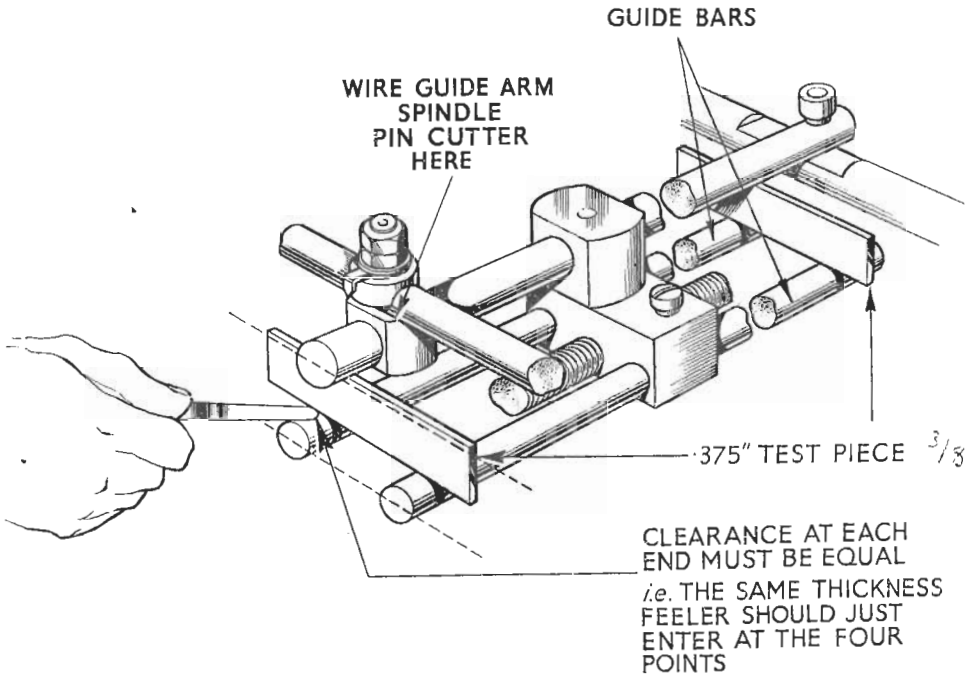
The "DOUGLAS" Standard Reel Carriers supplied for use with the "DOUGLAS" Wave Winder are fully described and illustrated in the Reel Carrier Manual. A copy should be kept close at hand when the Machine is set up. A point that should be noted is that the tension of the wire must never be excessive for wave winding, as this will cause stripping of the covering.

MAINTENANCE

Periodical maintenance of the Machine has an important bearing on the production of good coils, as any appreciable "play" in the parts mentioned will cause undue trouble. Therefore, it is essential to ensure that:—

1. The Cam Roller and Pin (Items Nos. 37 and 38) are a good running fit in the cam path. If wear has taken place both parts should be renewed. When the Pin is fitted it is important to see that the Pin is a good push fit in the Actuating Spindle (Item No. 39) and a revolving fit in the Cam (Item No. 31).
2. The Front Eye Bolt (Item No. 61) should be renewed when end play is apparent in the Wire Guide Spindle. When fitting a new Eye Bolt, the Lock Nuts (Item No. 67) should be adjusted to ensure that it revolves freely in the Wire Guide Arm Spindle without any "play".
3. The Clamping Nuts (Item No. 33) should be adjusted to eliminate end play in the Cam Shaft (Item No. 40); also the Screws (Item No. 32) in the Cam should be checked and tightened if found loose.
4. Should there be any play in the Wire Guide Arms (Plate No. 2), the four screws (Item No. 11) should be evenly adjusted. A simple test for correct adjustment is made by ensuring that the Arms will fall away from the Machine under their own weight, without any shake being apparent.
5. From time to time it may be found necessary to replace the Wire Guide Arm Spindle (Item No. 50). This part is supplied drilled, but has to be fitted to the Machine by pin cuttering. When performing this operation it is important to see that it lays parallel to the line AA (see accompanying sketch).

ALL THE OILING POINTS, INCLUDING THE CAM ROLLER, WORM DRIVE FOR REVOLUTION COUNTER, ETC., MUST BE FREQUENTLY LUBRICATED WITH A FINE GRADE MACHINE OIL. THIS PARTICULARLY APPLIES TO WIRE GUIDE ARM SPINDLE WHICH SHOULD BE OILED EVERY DAY.



NOTES AND EXAMPLES FOR SELECTING WAVE CHANGE GEARS AND COMPOUND GEAR TRAIN

WAVE CHANGE GEARS

To obtain various wave forms the gears E, F shown in the diagram beneath the Gear Tables are interchanged. The combinations available with the gears provided are shown below.

When quadruple, treble and double wave forms are being used, the drive must be on the Cam, and for half, third and quarter wave forms on the Pulley. If single wave forms are used the Cam or Pulley may be driven. It is most important that the "Direction of Rotation" of the Headstock Spindle is anti-clockwise (see Page 5).

GEAR COMBINATIONS FOR VARIOUS WAVE FORMS

WAVE FORM	E GEAR	F GEAR
QUARTER WAVE	24	96
THIRD WAVE ...	30	90
HALF WAVE ...	40	80
SINGLE WAVE ...	60	60

WAVE FORM	E GEAR	F GEAR
DOUBLE WAVE ...	80	40
TREBLE WAVE ...	90	30
QUADRUPLE WAVE	96	24

COMPOUND GEAR TRAIN

To determine the combination for the compound gear train on the extreme left hand end of the Machine, the overall diameter of wire is measured with a micrometer, and this reading is multiplied by 1·2. The result is substituted in the formulæ below.

Formulæ to be used for SINGLE, HALF, THIRD and QUARTER wave forms:—

$$= \frac{2 \times \text{WIDTH OF COIL}}{\text{OVERALL DIA. OF WIRE} \times 1.2} = X$$

Then

$$\frac{X}{X-1} = \frac{A \times C}{B \times D}$$

For example: Say a coil $\frac{1}{4}''$ wide has to be wound with wire whose overall diameter is 0·016″, then

$$\frac{2 \times \frac{1}{4}}{0{\cdot}016 \times 1{\cdot}2} = \frac{2 \times {\cdot}25}{0{\cdot}016 \times 1{\cdot}2} = \frac{0{\cdot}50}{0{\cdot}0192}$$

$$= 192)5000(26$$

384

1160

1152

8 Ignore remainder.

Therefore, $X = 26$

Substituting this in formula $\frac{X}{X-1} = \frac{26}{26-1}$

Therefore, $\frac{26}{25} = \frac{A \times C}{B \times D}$

and from Gear Table:

$A = 48 : B = 36 : C = 39 : D = 50.$

The same formula as above can, of course, also be used for the metric system.

Taking the last example, and substituting millimetre for inches:

$\frac{1}{4}'' = 6{\cdot}35$ mm.

$0{\cdot}016'' = 0{\cdot}406$ mm.

Then $\frac{2 \times 6{\cdot}35}{0{\cdot}406 \times 1{\cdot}2} = \frac{12{\cdot}7}{0{\cdot}4872}$

$= 4872)127000(26$

9744

29560

29232

328 Ignore remainder.

Therefore $X = 26$

Therefore, Gears A, B, C, D are the same as before.

When coils of DOUBLE, TREBLE and QUADRUPLE wave forms have to be wound, the width of the coil has to be multiplied by 4, 6 and 8 respectively.

For example: Treble wave form

$$\text{Formula} = \frac{6 \times \text{WIDTH OF COIL}}{\text{OVERALL DIA. OF WIRE} \times 1.2} = X$$

The gear combination shown in the Gear Table give retrogressive winding; that is to say, for each complete cam cycle the coil rotates slightly less than one complete revolution. For progressive winding, if the coil rotates slightly more than one complete revolution per cam cycle, the whole of the gear combination has to be reversed.

For example : Gear D is placed on Shaft A (see diagram beneath gear chart), and Gears B and C reversed.

Normally retrogressive windings give the best results, but there are some cases when the coil will not build up and progressive winding may be adopted.

COMPOUND GEAR TRAIN TABLE

$\frac{x}{x-1}$	A	B	C	D	$\frac{x}{x-1}$	A	B	C	D	$\frac{x}{x-1}$	A	B	C	D
400/399	50	42	32	38	144/143	48	39	36	44	50/49	50	35	30	42
391/390	46	40	34	39	133/132	42	36	38	44	49/48	42	36	35	40
385/384	44	32	35	48	126/125	48	40	42	50	46/45	46	30	32	48
375/374	50	34	30	44	125/124	50	31	30	48	45/44	48	32	30	44
370/369	40	36	37	41	124/123	48	36	31	41	42/41	50	41	42	50
352/351	44	36	32	39	120/119	48	34	30	42	41/40	50	40	41	50
342/341	38	31	36	44	117/116	36	29	39	48	40/39	50	39	40	50
323/322	38	28	34	46	116/115	48	30	29	46	39/38	50	38	39	50
321/320	40	29	32	44	115/114	40	38	46	48	38/37	50	37	38	50
300/299	50	39	36	46	112/111	48	36	28	37	37/36	50	36	37	50
288/287	48	41	36	42	111/110	48	40	37	44	36/35	50	35	36	50
276/275	48	44	46	50	105/104	30	39	42	32	35/34	50	34	35	50
273/272	42	34	39	48	100/99	48	40	32	38	34/33	48	36	34	44
260/259	39	42	40	37	96/95	40	38	48	50	33/32	44	32	36	48
253/252	44	48	46	42	93/92	48	32	31	46	32/31	50	31	32	50
248/247	46	39	31	38	92/91	46	39	36	42	31/30	50	30	31	50
246/245	36	42	41	35	88/87	44	29	32	48	30/29	50	29	30	50
231/230	42	40	44	46	85/84	50	40	34	42	29/28	50	28	29	50
222/221	36	39	37	34	78/77	48	42	39	44	26/25	48	36	39	50
221/220	39	30	34	44	77/76	42	48	44	38	25/24	50	40	35	42
210/209	40	44	42	38	76/75	48	36	38	50	24/23	50	46	48	50
205/204	40	34	41	48	75/74	50	37	36	48	23/22	50	44	46	50
204/203	36	29	34	42	70/69	42	36	40	46	22/21	50	42	44	50
196/195	28	39	42	30	69/68	46	34	36	48	21/20	50	40	42	50
190/189	40	36	38	42	66/65	44	39	36	40	20/19	50	38	40	50
187/186	44	31	34	48	65/64	50	40	39	48	19/18	50	36	38	50
185/184	50	40	37	46	64/63	48	36	32	42	18/17	50	34	36	50
176/175	40	35	44	50	63/62	42	31	36	48	17/16	50	32	34	50
171/170	38	34	36	40	58/57	48	36	29	38	16/15	50	30	32	50
165/164	44	32	30	41	57/56	36	28	38	48	15/14	50	28	30	50
161/160	42	48	46	40	56/55	42	30	32	44	14/13	50	39	42	50
156/155	40	31	39	50	55/54	40	36	44	48	13/12	50	36	39	50
154/153	44	34	28	36	52/51	39	34	32	36	12/11	50	44	48	50
148/147	40	35	37	42	51/50	48	32	34	50	11/10	50	40	44	50

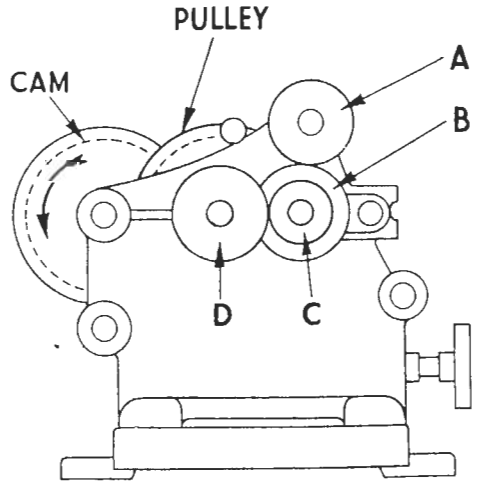


DIAGRAM OF GEARS A, B, C, D FOR COMPOUND TRAIN

Gears provided: 28, 29, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 41, 42, 44, 46, 48 and two 50.

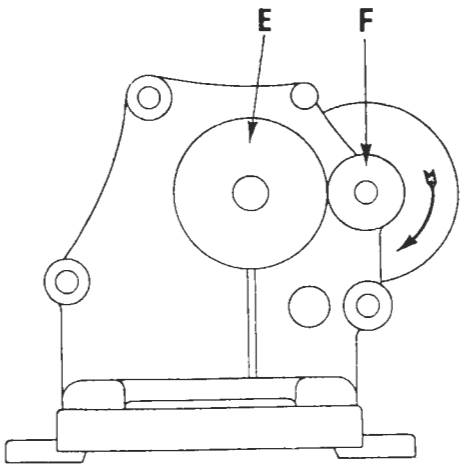


DIAGRAM FOR WAVE CHANGE GEARS E.F.

Gears provided : 24, 30, 40, two 60, 80, 90 and 96.

Plate 1—Parts List

ITEM NO.	DESCRIPTION	PART NO.	NO. OFF
1	Complete Machine	50043/A	
2	Handle Complete	20382/A	1
3	Driving Pulley	20351/3	1
4	Screw Securing Item 3	AS.41	1
5	Driving Shaft complete with Gear Collar	20391/A	1
6	Revolution Counter Complete	20386/A	1
7	Winding Shaft complete with Gear Collar	20384/A	1
8	Clamping Nuts	12185/2	2
9	Inner Guard	20227/3	1
10	Outer Guard	20228/3	1
11	Fluted Cone	10780/2	1
12	Screw Securing Item 11	AS.23	1
13	Guard Support Pillars	12188/2	2
14	Terminal Nuts	10807/2	2
15	Cone Centre	10595/A	1
16	Tailstock Spindle complete with Thrust Ball	12187/A	1
17	Tailstock Casting	40288/3	1
18	Bolts Securing Item 17	BSF.11	2
19	Nuts for Item 18	N.29	2
20	Dowel Pins locating Item 17	20339/23	2
21	Hand Wheel	20325/4	1
22	Eye Bolt	10597/1	1
23	End Bracket	11844/3	1
24	Screws Securing Item 23	AS.8	2
25	Dowel Pins for Item 23	20339/35	2
26	Base	40173/3	1
27	Left Hand Inner Guard	20229/3	1
28	Left Hand Outer Guard	20230/3	1
29	Guard Support Pillars	12188/1	2
30	Terminal Nuts	10807/2	2
31	Cam	20350/3	1
32	Screws Securing Item 31	AS.41	2
33	Clamping Nuts	12185/2	2
34	Handle Driving Pin	20339/2	1
35	Cam Roller Shaft	11821/1	1
36	Screw Securing Item 38	AS.29	1
37	Cam Roller	12194/1	1
38	Cam Roller Pin	12195/1	1
39	Actuating Spindle	12190/1	1
40	Cam Shaft Complete with Gear Collar	20390/A	1
41	Wave Change Gear, 24 teeth	30018/2	1
42	Wave Change Gear, 30 teeth	30018/7	1
43	Wave Change Gear, 40 teeth	30018/20	1
44	Wave Change Gear, 60 teeth	30018/36	2
45	Wave Change Gear, 80 teeth	30018/46	1
46	Wave Change Gear, 90 teeth	30018/48	1
47	Wave Change Gear, 96 teeth	30018/49	1
48	Special Washers for Change Gears	10586/1	5
49	Screws Retaining Change Gears	S.224	5
50	Wire Guide on Spindle Block	11794/1	1
51	Throw Adjusting Block	12189/2	1
52	Screw Locking Item 51 Throw	S.219	1
53	Eye Bolt for Adjusting Block	12180/1	1
54	Lock Nuts for Item 53	N.29	2
55	Guide Bars	12191/1	2
56	Screws Securing Item 55	AS.23	2
57	Throw Adjusting Screw Complete	11737/A	1
58	Lock Nuts for Item 57	N.27	2
59	Hand Wheel	20325/6	1
60	Screw Securing Item 59	S.456	1
61	Front Eye Bolt	12179/1	1
62	Throw Indicator	20066/1	1
63	Screws Securing Item 62	S.463	2
64	Clamping Piece	12192/A	1
65	Pointer	10331/2	1
66	Washer	W.21	1
67	Lock Nuts for Item 61	N.27	2
68	Headstock Casting	40185/3	1
69	Quadrant Bolt	12182/1	1
70	Washer for Item 69	W.23	1
71	Nut Securing Item 69	N.30	1
72	Change Gear, 28 teeth	30018/4	1
73	Change Gear, 29 teeth	30018/5	1
74	Change Gear, 30 teeth	30018/7	1
75	Change Gear, 31 teeth	30018/8	1
76	Change Gear, 32 teeth	30018/9	1
77	Change Gear, 34 teeth	30018/10	1
78	Change Gear, 35 teeth	30018/11	1
79	Change Gear, 36 teeth	30018/13	1
80	Change Gear, 37 teeth	30018/15	1
81	Change Gear, 38 teeth	30018/16	1
82	Change Gear, 39 teeth	30018/18	1
83	Change Gear, 40 teeth	30018/19	1
84	Change Gear, 41 teeth	30018/21	1
85	Change Gear, 42 teeth	30018/22	1
86	Change Gear, 44 teeth	30018/24	1
87	Change Gear, 46 teeth	30018/27	1
88	Change Gear, 48 teeth	30018/29	1
89	Change Gear, 50 teeth	30018/31	2

PLATE 1 "DOUGLAS" WAVE WINDER

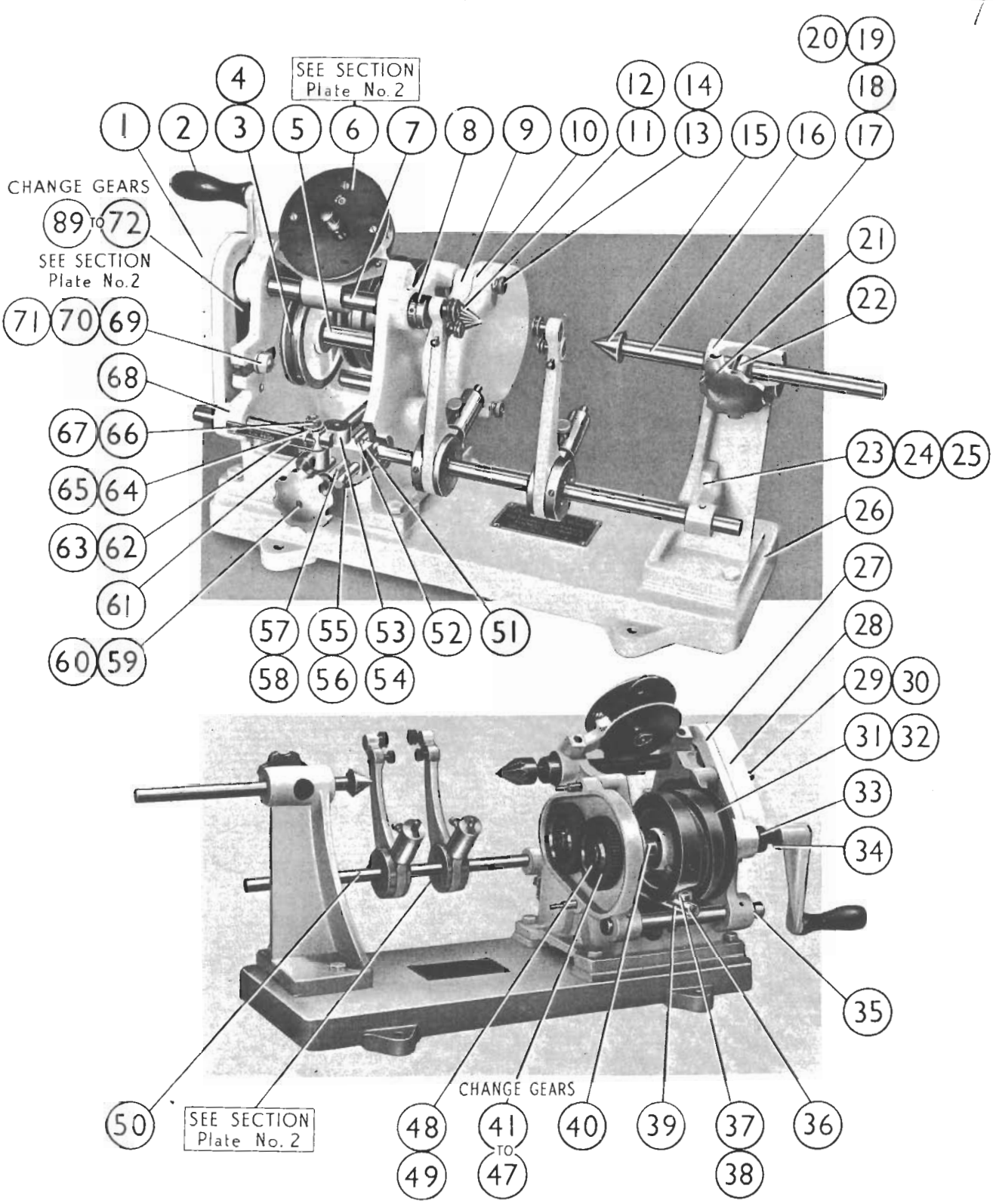


Plate 2—Parts List

GEAR DETAILS

ITEM NO.	DESCRIPTION	PART NO.	NO. OFF	ITEM NO.	DESCRIPTION	PART NO.	NO. OFF
1	Gear Quadrant Complete	12193/A	1	3	Gear Collet Assembly	12196/A	1
2	Idler Assembly	10831/A	1	4	Pin Securing Item 3	20339/22	1

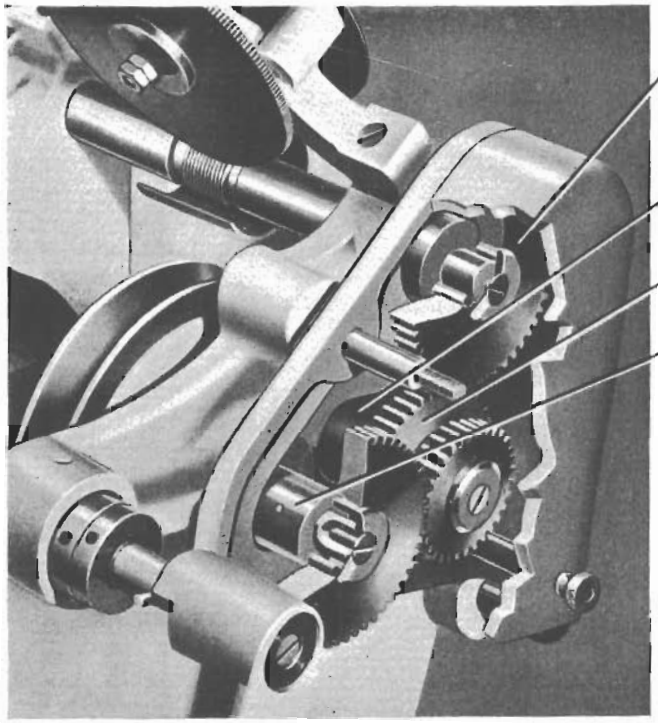
WIRE GUIDE ARM ASSEMBLY

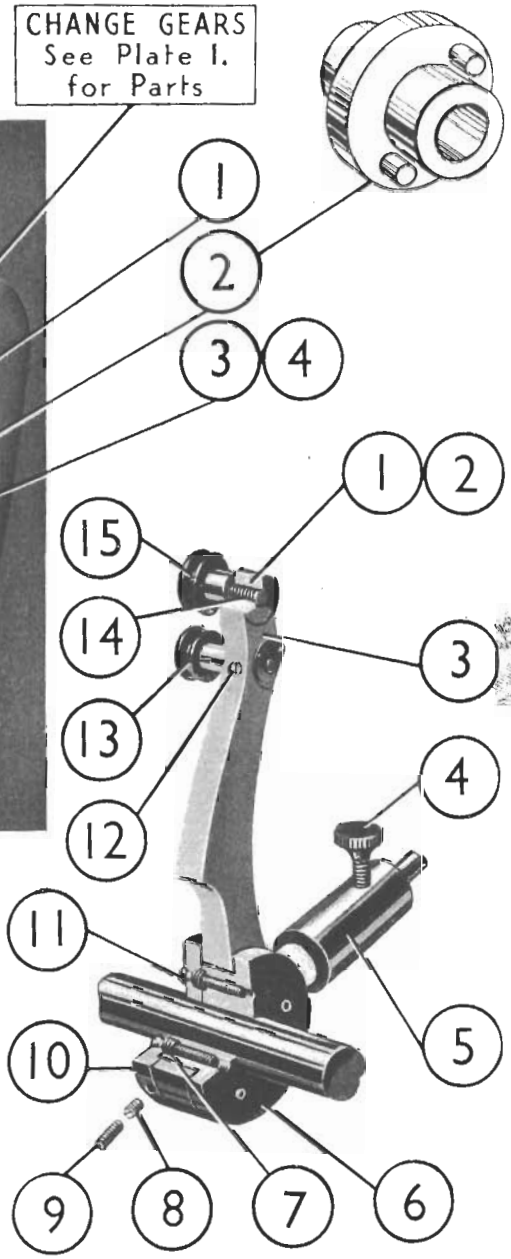
ITEM NO.	DESCRIPTION	PART NO.	NO. OFF	ITEM NO.	DESCRIPTION	PART NO.	NO. OFF
1	Wire Guide Arm Assembly R.H.	20387/A	1	7	Springs	13160/1	4
2	Wire Guide Arm Assembly L.H. (shown)	20387/B	1	8	Special Grub Screw	14208/1	1
3	Wire Guide Arm with Weight Spindle	14207/A	1	9	Clamping Screw	AS.32	1
4	Special Screw Securing Item 5	12198/2	1	10	Washer for Wire Guide Arm	12805/1	1
5	Weight for Wire Guide Arm	12175/2	1	11	Screws Securing Item 6	S.454	4
6	Wire Guide Bush	12804/2	1	12	Screw Securing Item 13	S.412	1
				13	Wire Guide Stud	12174/1	1
				14	Shoulder Screw for Item 15	12210/1	1
				15	Wire Guide Pulley	12200/1	1

REVOLUTION COUNTER ASSEMBLY

ITEM NO.	DESCRIPTION	PART NO.	NO. OFF	ITEM NO.	DESCRIPTION	PART NO.	NO. OFF
1	Large Calibrated Dial	11615/1	1	11	Trip Arm	12667/1	1
2	Screws Securing Item 1	S.457	2	12	Bridge Casting	10630/2	1
3	Knob	10223/1	1	13	Screw Securing Item 12	AS.8	1
4	Small Dial Complete with Pins	12673/A	1	14	Spindle	12665/1	1
5	Small Dial Screw	S.456	1	15	I.O.M. Washer for Item 14	12668/1	1
6	Nut for Item 5	N.36	1	16	Lock Nuts for Item 14	N.22	2
7	Small Dial Bush	12669/1	1	17	Pointer	12664/1	1
8	Leaf Spring	12666/1	1	18	Guard	10328/2	1
9	Screw Securing Item 8.	S.674	1	19	Screws Securing Item 18	S.462	2
10	Worm Wheel	12663/1	1				

PLATE 2 "DOUGLAS" WAVE WINDER DETAILS





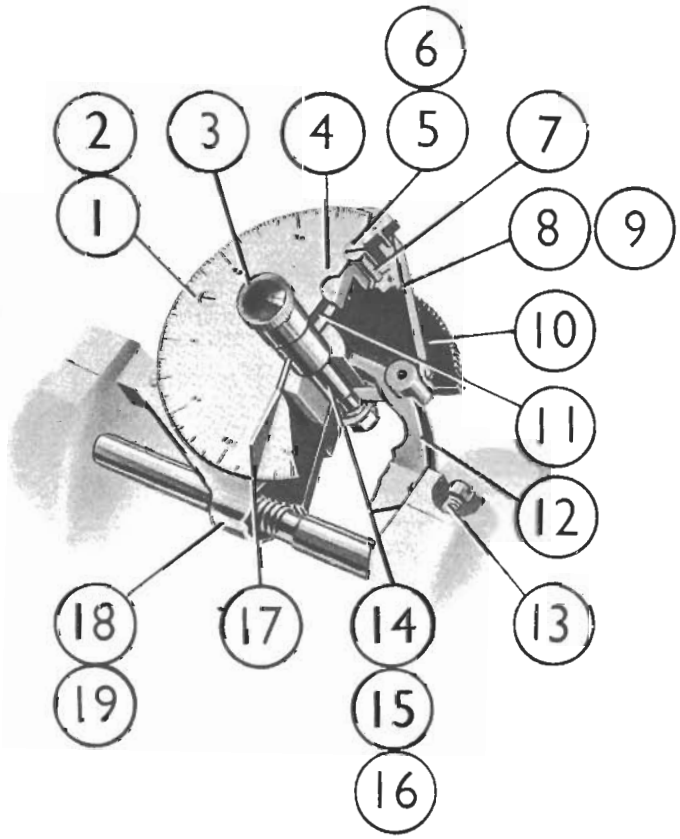
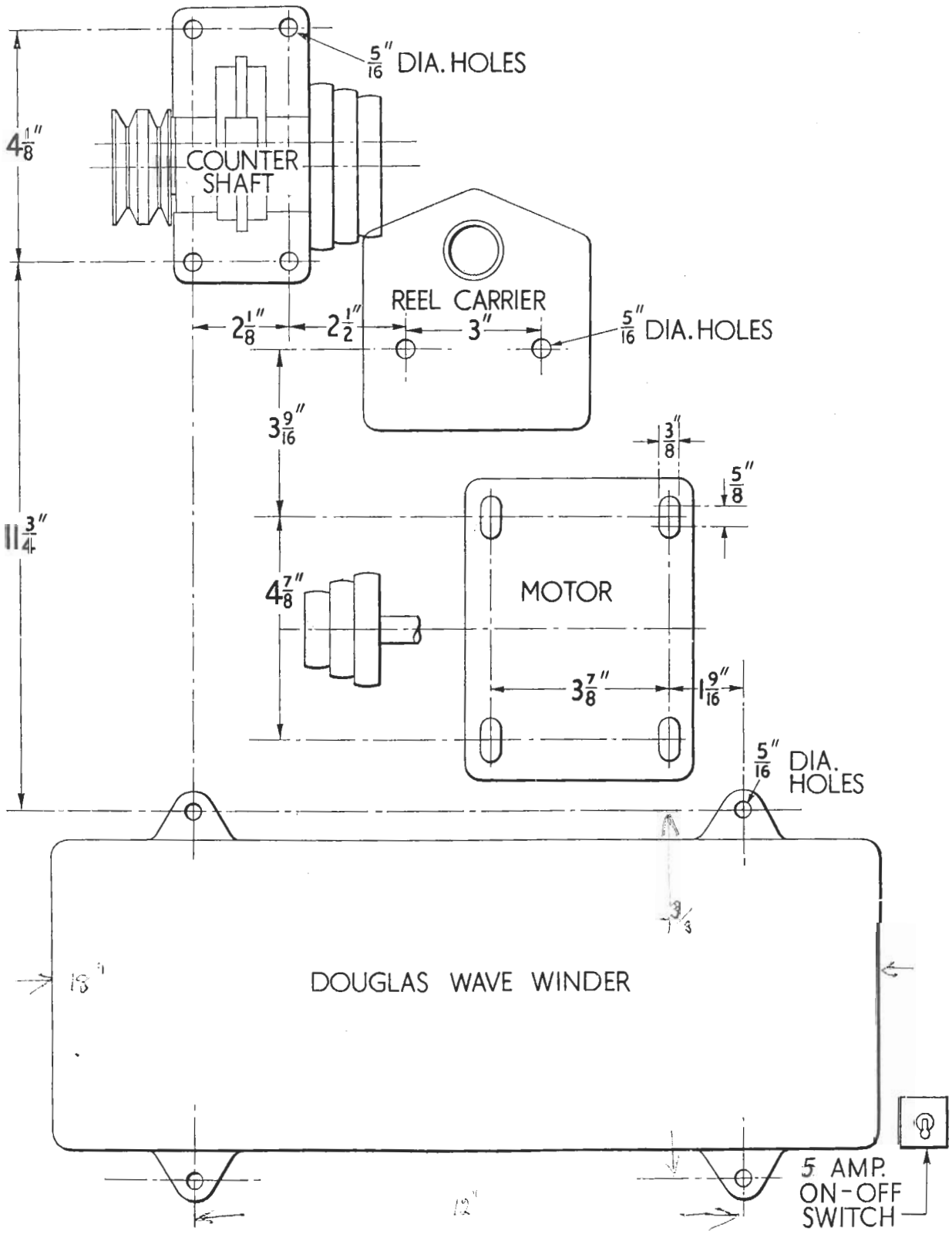


PLATE 3 BENCH LAYOUT

(APPLICABLE FOR BOTH "DOUGLAS" WAVE WINDER AND PROGRESSIVE WAVE WINDER)



THE "DOUGLAS" WAVE WINDER WITH PRE-DETERMINED REVOLUTION COUNTER

The "DOUGLAS" Wave Winder may be supplied, or existing models modified, to incorporate a Pre-Determined Revolution Counter and a special "DOUGLAS" Countershaft fitted with an electro-magnetic trip to stop the Machine at a pre-determined number of turns.

With this device the Machine can be foot operated, the clutch in this special Countershaft allowing for a slow start to be made at the commencement of winding.

Since the Wave Winder is generally the same as that already described, only the special parts and fitments are described here.

The site for a "DOUGLAS" Wave Winder with a special Countershaft needs to be somewhat different from that already described, and a proposed scheme is shown on Plate No. 5. To fit the Foot Treadle it is necessary that a hole approximately 1" (25 mm.) diameter be cut in the bench to clear the Spring on the Treadle Rods, and the Treadle Bracket may then be secured to the floor in a convenient place for the operator to reach. This will mean that the Rods are at an angle sloping away from the operator and any adjustment required may be made by positioning the Clamping Blocks on the Rods.

"DOUGLAS" COUNTERSHAFT WITH ELECTRO-MAGNETIC TRIP

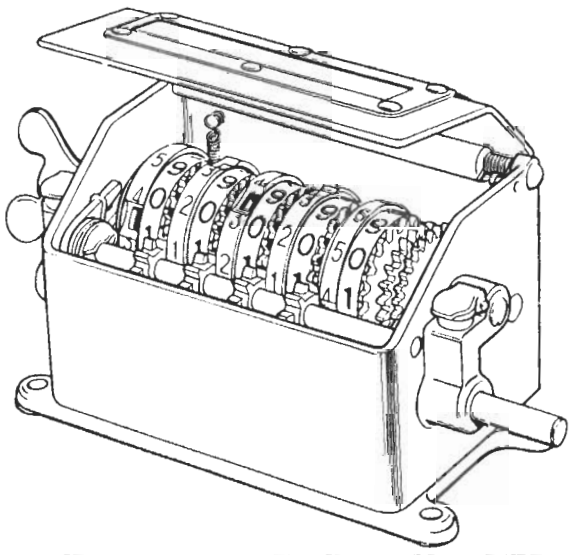
This special "DOUGLAS" Countershaft is illustrated on Plate No. 4, and comprises a clutch head, together with a Solenoid, etc., connected electrically to the Revolution Counter. With this device, the motor is constantly running, and in practice it is found that there is generally no over-run of turns. Referring to Plate No. 4, it will be noted that an adjusting screw is fitted to the armature of the Solenoid and operates in conjunction with the Micro Switch (Item No. 19). The purpose of the screw is to cut off the current to the Solenoid once it has operated. This is necessary, since the Solenoid operates on A.C. mains and is inclined to be noisy if the current is allowed to continually pass through the coil. The adjusting screw should be re-set if it is found that it does not come into contact with the Micro Switch when the armature is drawn towards the coil. When connecting this device to the mains it should be wired in series with the switch of the Revolution Counter.

REVOLUTION COUNTER

When the "DOUGLAS" Wave Winder is fitted with the pre-determined Revolution Counter a special coupling and bracket are necessary, and advice will be given by the manufacturers regarding this adaptation to existing Machines.

The Revolution Counter is a Veeder-Root pre-set type, and is set up by the following method. The key of the Counter should be rotated so that the figures shown on the white rollers are all noughts; the cover should then be raised and the aluminium rollers pushed to the right and then rotated until the appropriate figure is opposite the window. The cover is then allowed to return to its normal position (see accompanying sketch).

In operation, the aluminium rollers run back to zero, whilst the white rollers show the number of turns which have been wound on to the coil. When the aluminium rollers reach zero the switch at the back of the Counter is closed; this energises the Solenoid coil, which in turn releases the clutch lever on the Headstock.



VEEDER-ROOT PRE-SET ELECTRICAL TYPE COUNTER AS FITTED TO SPECIAL DOUGLAS WAVE WINDER

Plate 4—Parts List

ITEM NO.	DESCRIPTION	PART NO.	NO. OFF
1	Flexible Coupling to Micro Switch . . .	13814/1	1
2	Solenoid Assembly (including coil) . . .	20484/A	1
3	Solenoid Coil . . .	13809/1	1
4	Double Vee Pulley . .	10802/2	1
5	Screw Securing Item 4	AS.32	1
6	Revolution Counter (predetermined type) . .	10217/1	1
7	Screw Securing Item 6	S.412	4
8	Nuts for Item 7 . .	N.36	4
9	Washers for Item 7 .	W.16	4
10	Bracket for Revolution Counter	40029/24	1
11	Screws Securing Item10	S.449	2
12	Revolution Counter Coupling	11770/1	1
13	Screws for Item 12 .	AS.23	2
14	Spindle Extension . .	11772/1	1
15	Special Gear Guard .	20924-Z	1
16	Drive Pin	11769/1	1
17	Adapter	11771/1	1
18	Special Drive Pin . .	20339/1	2
19	Micro Switch . . .	11318/4	1
20	Housing for Micro Switch	20410/A	1
21	Spring for Release Arm	11908/1	1
22	Release Arm Assembly	13813/A	1
23	Bearing Bracket . . .	12743/2	1
24	Foot Treadle Complete Assembly	40207/A	1
25	Spring for Foot Treadle	10880/1	1
26	Complete Assembly .	50092/A	

PLATE 4 "DOUGLAS" COUNTERSHAFT

WITH ELECTRO-MAGNETIC TRIP

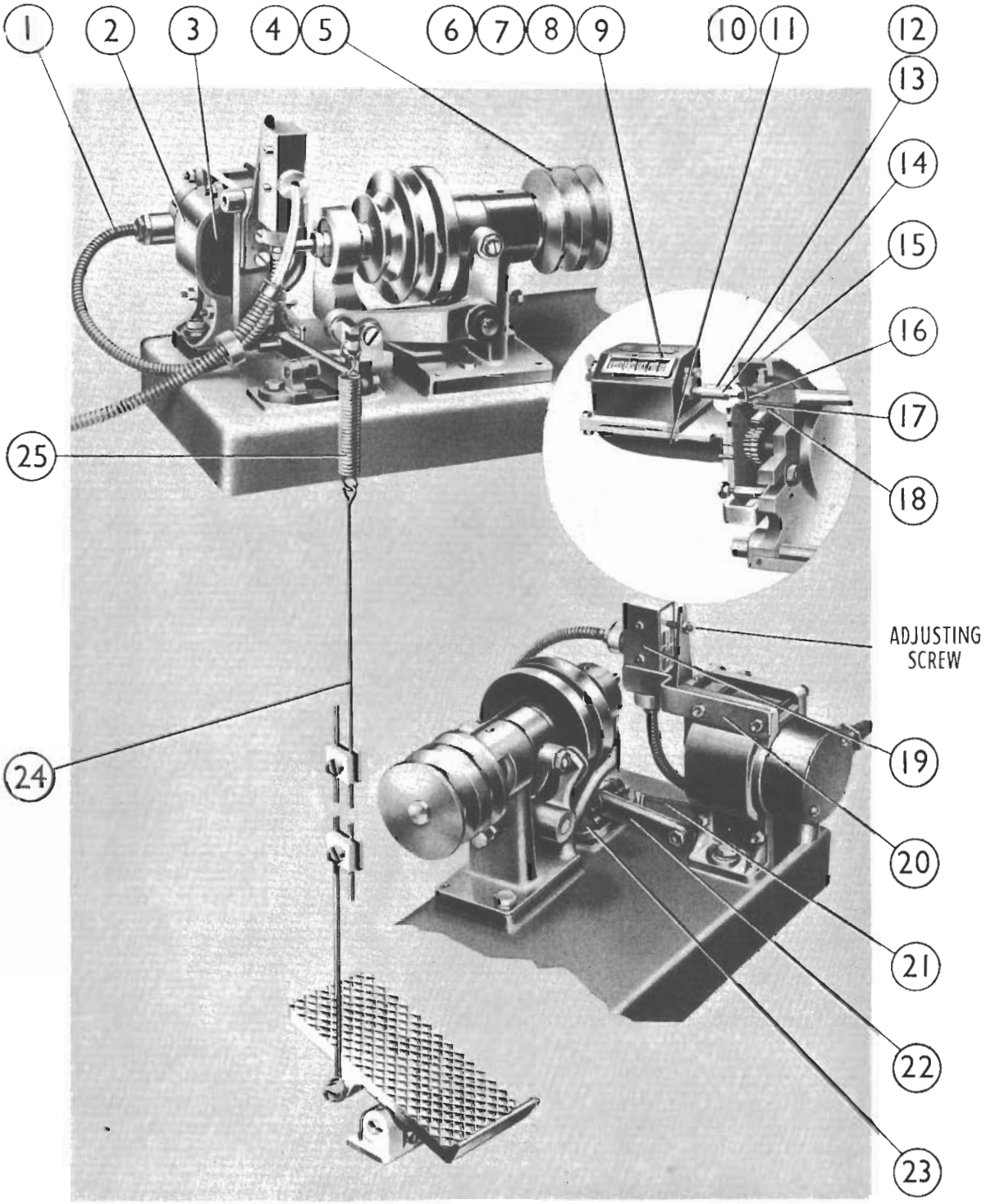
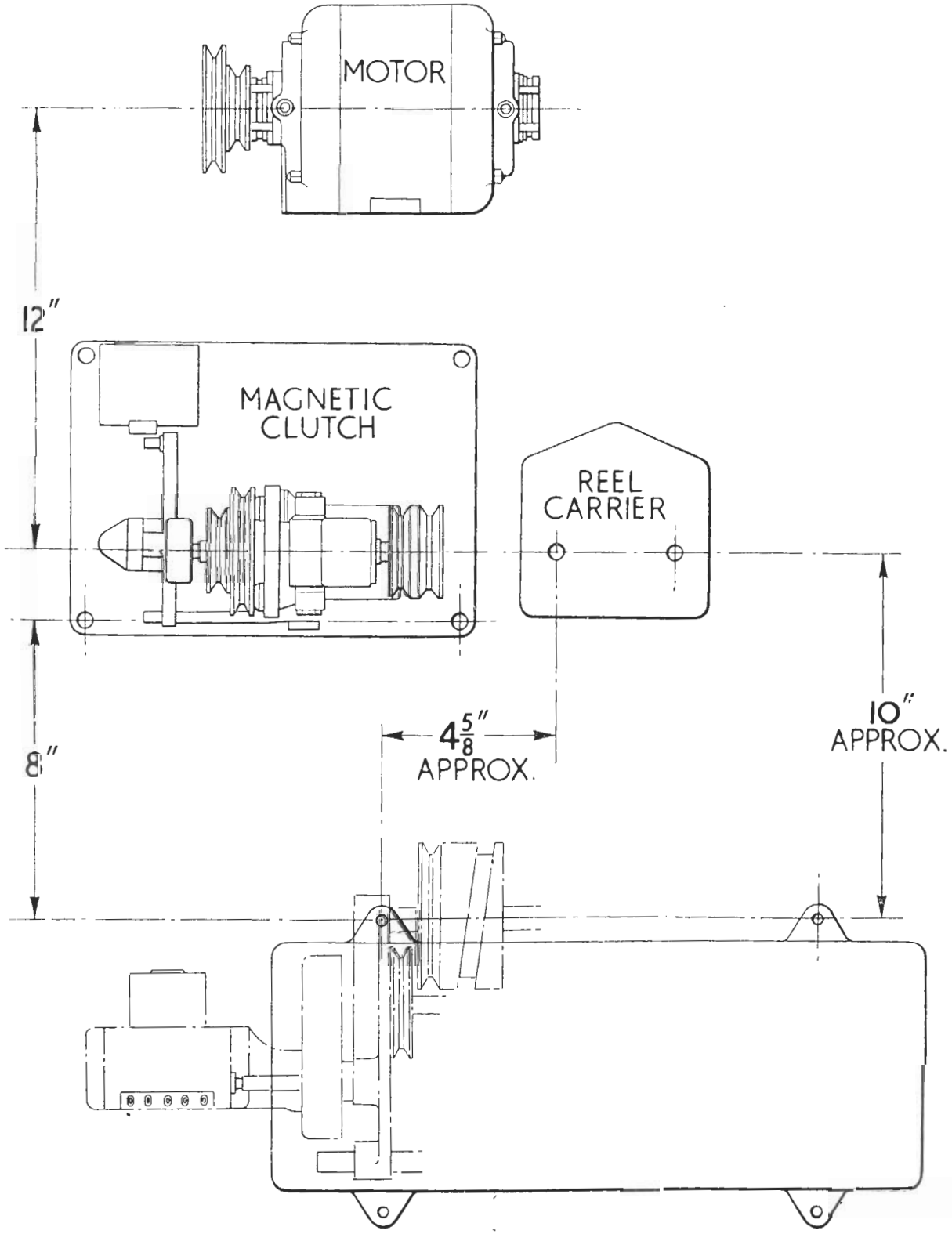


PLATE 5 BENCH LAYOUT



THE "DOUGLAS" PROGRESSIVE WAVE WINDER

The "DOUGLAS" Progressive Wave Winder is a Universal Machine for winding either wave wound or progressive wave wound coils. An illustration of this Machine is shown on Plate No. 6 and it will be noted that only one Wire Guide Arm is fitted. This means that with standard equipment only one wave wound coil can be wound at one setting. Should it be necessary to use the Machine for multiple pie winding a special Wire Guide Arm Spindle can be fitted by removing the Lead Screw and Carriage Assembly and fitting Wire Guide Arms, similar to those used with the "DOUGLAS" Wave Winder (see Plate No. 2). This additional equipment together with extra "DOUGLAS" Standard Reel Carriers, can be supplied by the manufacturers at extra cost.

EQUIPMENT

The equipment supplied with this Machine when it leaves the factory includes :

1. One "DOUGLAS" Standard Reel Carrier.
2. One set of Change Gears, comprising nineteen Wave Compound Gears and eight Wave Form Gears.
3. One set of Traverse Gears (eighteen).
4. One $\frac{1}{4}$" - $\frac{5}{16}$" Spanner for adjusting the Gear Quadrant.
5. Two small hexagon wrenches for the 0 B.A. and 4 B.A. grub screws.
6. One length of round leather belt (sufficient to make two driving belts.)

INSTALLING THE "DOUGLAS" PROGRESSIVE WAVE WINDER

The procedure for installing this Machine is the same as for the "DOUGLAS" Wave Winder and the instructions given on Page 4 and Plate 3 should be carefully followed.

SETTING UP THE MACHINE

PROGRESSIVE WAVE WINDING

The effective difference between a progressive wave wound coil and the conventional pie wound coil (wave winding) is the laying of the adjacent turns of wire. Since this is affected by the many adjustments that can be made to the "DOUGLAS" Progressive Wave Winder, a brief explanation of this will be helpful.

When a pie wound coil is being wound, the adjacent turns of wire are approximately the same distance apart for either direction of "throw" of the Wire Guide Button (see Plate No. 6, Item 60).

Whereas with progressive wave winding the "throw" of the Wire Guide Button is alternately in and out of phase according to the movement of the Wire Guide Button. In other words, the relative speed of the Button and the Coil are different for the two directions of the "throw" of the Button. Consequently, when the Wire Guide Button is throwing (cam action) in phase with the movement of the Wire Guide Arm (traverse) the adjacent turns of wire are more widely spaced than when the Button is out of phase with this movement.

Many laboratory tests have been made with the "DOUGLAS" Progressive Wave Winder and it has been found that a considerable number of winding patterns can be wound. The accompanying illustration shows two typical examples.

Due to this considerable scope of the Machine it is not practicable to lay down a formula for the various Machine settings, as individual coil design for a given inductance vary. To produce a coil similar to that illustrated on the small coil former, Page 9, the following materials and gears were used:—

Coil Former :	0·25″ (6·35 mm.) diam.
Double Silk Wire :	0·006″ (0·15 mm.) overall diam.
Traverse Gears :	30 — 60 — 36 — 75
Wave Compound Gears :	50 — 35 — 48 — 50
Wave Gears :	60 — 60
Throw :	0·156″ (3·97 mm.).

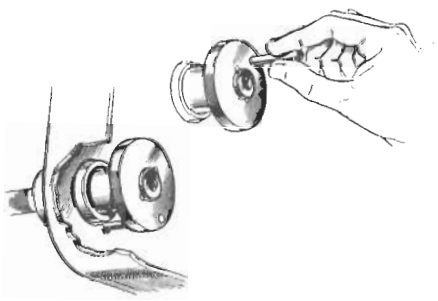
The completed winding using this setting will resemble a number of very narrow wave wound coils closely packed together along the coil former.

Although the Machine setting can only be made by trial and error to produce a coil of required inductance, following a little experience with the Machine the setting will be quickly achieved and for future reference the gear combination and Wire Guide Arm "throw" should be noted.

It is important that the Wire Guide Button with the radius face is used for progressive wave winding.

WAVE WINDING

To use the Machine for wave winding (pie coils) the traverse gear "D" on the Lead Screw should be removed and the Gear Blank and Pin Assembly placed in its position so that the pin enters the hole in the Gear Guard as shown in the accompanying sketch.



This is to prevent any movement of the Wire Guide Arm due to vibration during winding. The Wire Guide Button with the flat face should then be placed in the Wire Guide Arm, and with this done the instructions on Page 6 for the "DOUGLAS" Wave Winder, carefully followed.

The changing of position of the Wire Guide Arm between pies does, however, differ on this Machine. This may be carried out by either of the following two methods : Firstly, the Half Nut Arm, Item 43, may be lifted away from the Lead Screw, Item 72, by depressing the Release Stud, Item 42 Plate No. 6, the carriage may then be moved to the desired position and the Half Nut allowed to re-engage the Lead Screw. The second method, which gives a very accurate spacing of the pie windings, is to remove the Gear Blank and Pin Assembly having completed the first pie winding and use this assembly as a hand wheel (see sketch below), to rotate the Lead Screw. It is, of course, important to replace the Gear Blank and Pin Assembly to its former position in order to lock the Lead Screw.

When using the "DOUGLAS" Progressive Wave Winder for wave winding the tables and examples as shown on Pages 8 and 9 should be followed. The maintenance of the "DOUGLAS" Progressive Wave Winder is somewhat similar as for the "DOUGLAS" Wave Winder and the information given on Page 7 generally applies.

To fit the special Wire Guide Arm Spindle previously referred to, for multiple pie winding, the Taper Pins, Item 77, in the Collars, Item 76 Plate No. 6, should be driven out and the Lead Screw, Item 72, can then be withdrawn from the left hand end of the Machine. The grub screws securing the Top and Bottom Guide Rods, Items 69 and 71, should be loosened and the Guide Rods withdrawn from the left hand end of the Machine at the same time supporting the Carriage Assembly, Item 64, in the right hand.

IMPORTANT—Care must be taken to ensure that the Lead Screw and Guide Rods are not distorted as this will impair efficient working when replaced.

The special Wire Guide Arm Spindle may now be fitted to the Machine and to ensure that the Collars, Item 76, are pinned in the correct place, the Throw Adjusting Block, Item 51, Plate No. 1, should be set in a position which would allow the maximum throw of the Spindle at the right hand side. The special Spindle should then be pushed into the bearing Support Bracket, Item 36, so that there is a clearance of $\frac{1}{16}$″ between the end of the Spindle and the bottom of the Bush, Item 35. The holes in the Collars are then drilled through the special Spindle and reamed to suit the Taper Pins. It is important to ensure that the Collars fit tightly against the Clamping Piece, Item 80, to eliminate any "end play."

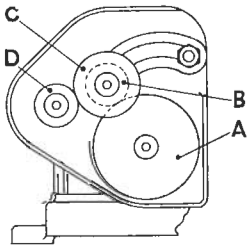
It is, of course, essential to place the required number of Wire Guide Arms, Item 1, Plate 2, on to the Spindle before pinning the Collars.

PROGRESSIVE TRAVERSE GEAR TABLE

TRAVERSE PER TURN IN INCHES	A	B	C	D	TRAVERSE PER TURN IN INCHES	A	B	C	D	TRAVERSE PER TURN IN INCHES	A	B	C	D
*0·0010″	24	75	25	80	0·0100″	30	40	48	36	0·0200″	50	40	48	30
*0·0011″	24	72	25	75	0·0102″	34	28	42	50	0·0202″	40	44	80	36
*0·0012″	24	70	28	80	0·0104″	65	30	36	75	0·0204″	40	42	60	28
*0·0013″	24	65	25	70	0·0106″	30	46	65	40	0·0206″	34	44	80	30
*0·0014″	24	60	28	80	0.0108″	36	28	42	50	0.0208″	38	40	70	32
*0·0015″	24	70	35	80	0.0110″	42	28	44	60	0.0210″	42	50	70	28
*0·0016″	24	60	30	75	0·0112″	42	30	48	60	0·0212″	42	44	80	36
*0·0017″	25	65	32	72	0·0114″	38	28	42	50	0·0214″	44	48	70	30
*0·0018″	28	70	36	80	0·0116″	30	60	65	28	0·0216″	44	40	55	28
*0·0019″	24	70	40	72	0·0118″	38	46	60	42	0·0218″	48	44	60	30
*0·0020″	28	60	30	70	0·0120″	40	28	42	50	0·0220″	44	40	60	30
0·0022″	30	80	44	75	0·0122″	32	30	48	42	0·0222″	46	38	55	30
0·0024″	30	60	36	75	0·0124″	36	42	55	38	0·0224″	44	42	60	28
0·0026″	38	55	30	80	0·0126″	34	60	80	36	0·0226″	46	40	55	28
0·0028″	30	50	28	60	0·0128″	32	30	48	40	0·0228″	34	32	60	28
0·0030″	30	50	30	60	0·0130″	48	60	65	40	0·0230″	46	40	60	30
0·0032″	30	50	32	60	0·0132″	42	28	44	50	0·0232″	46	34	48	28
0·0034″	30	50	34	60	0·0134″	32	44	70	38	0·0234″	36	44	80	28
0·0036″	30	50	36	60	0·0136″	34	30	48	40	0·0236″	38	46	80	28
0·0038″	30	50	38	60	0·0138″	42	28	46	50	0·0238″	40	36	60	28
0·0040″	30	50	40	60	0·0140″	28	30	60	40	0·0240″	36	30	60	30
0·0042″	30	50	42	60	0·0142″	38	28	46	44	0·0242″	50	55	80	30
0·0044″	30	50	44	60	0·0144″	36	30	48	40	0·0244″	46	44	70	30
0·0046″	30	50	46	60	0·0146″	42	30	48	46	0·0246″	46	44	80	34
0·0048″	30	50	48	60	0·0148″	44	65	70	32	0·0248″	46	34	55	30
0·0050″	30	30	40	80	0·0150″	30	30	60	40	0·0250″	30	30	70	28
0·0052″	28	70	65	50	0·0152″	38	30	48	40					
0·0054″	48	40	36	80	0·0154″	42	30	44	40					
0·0056″	42	30	30	75	0·0156″	36	50	65	30					
0·0058″	44	38	30	60	0·0158″	30	38	60	30					
0·0060″	30	30	36	60	0·0160″	30	50	80	30					
0·0062″	30	55	50	44	0·0162″	34	42	60	30					
0·0064″	36	30	32	60	0·0164″	34	38	55	30					
0·0066″	36	60	55	50	0·0166″	80	46	42	44					
0·0068″	36	30	34	60	0·0168″	42	40	48	30					
0·0070″	28	50	60	48	0·0170″	34	40	60	30					
0·0072″	36	60	48	40	0·0172″	44	40	50	32					
0·0074″	42	65	55	48	0·0174″	40	46	60	30					
0·0076″	30	30	38	50	0·0176″	44	40	48	30					
0·0078″	42	70	65	50	0·0178″	46	42	65	40					
0·0080″	30	30	40	50	0·0180″	36	40	60	30					
0·0082″	40	36	48	65	0·0182″	60	36	46	42					
0·0084″	30	30	42	50	0·0184″	46	40	48	30					
0·0086″	65	34	36	80	0·0186″	34	40	70	32					
0·0088″	30	30	44	50	0·0188″	32	40	80	34					
0·0090″	30	28	42	50	0·0190″	38	40	60	30					
0·0092″	30	30	46	50	0·0192″	48	50	60	30					
0·0094″	40	65	55	36	0·0194″	32	44	80	30					
0·0096″	30	30	48	50	0·0196″	48	50	70	30					
0·0098″	28	50	70	40	0·0198″	38	48	80	32					

FORMULA TO FIND GEARS A.B.C. & D.

$$\frac{\text{DIA. OF WIRE}}{0{\cdot}010} = \frac{A}{B} \times \frac{C}{D}$$



POSITION OF GEARS A.B.C. & D.

GEARS PROVIDED

28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 55, 60, 65, 70, 75, 80

ADDITIONAL GEARS 24, 25 & 72, ARE REQUIRED FOR COMBINATIONS THUS*

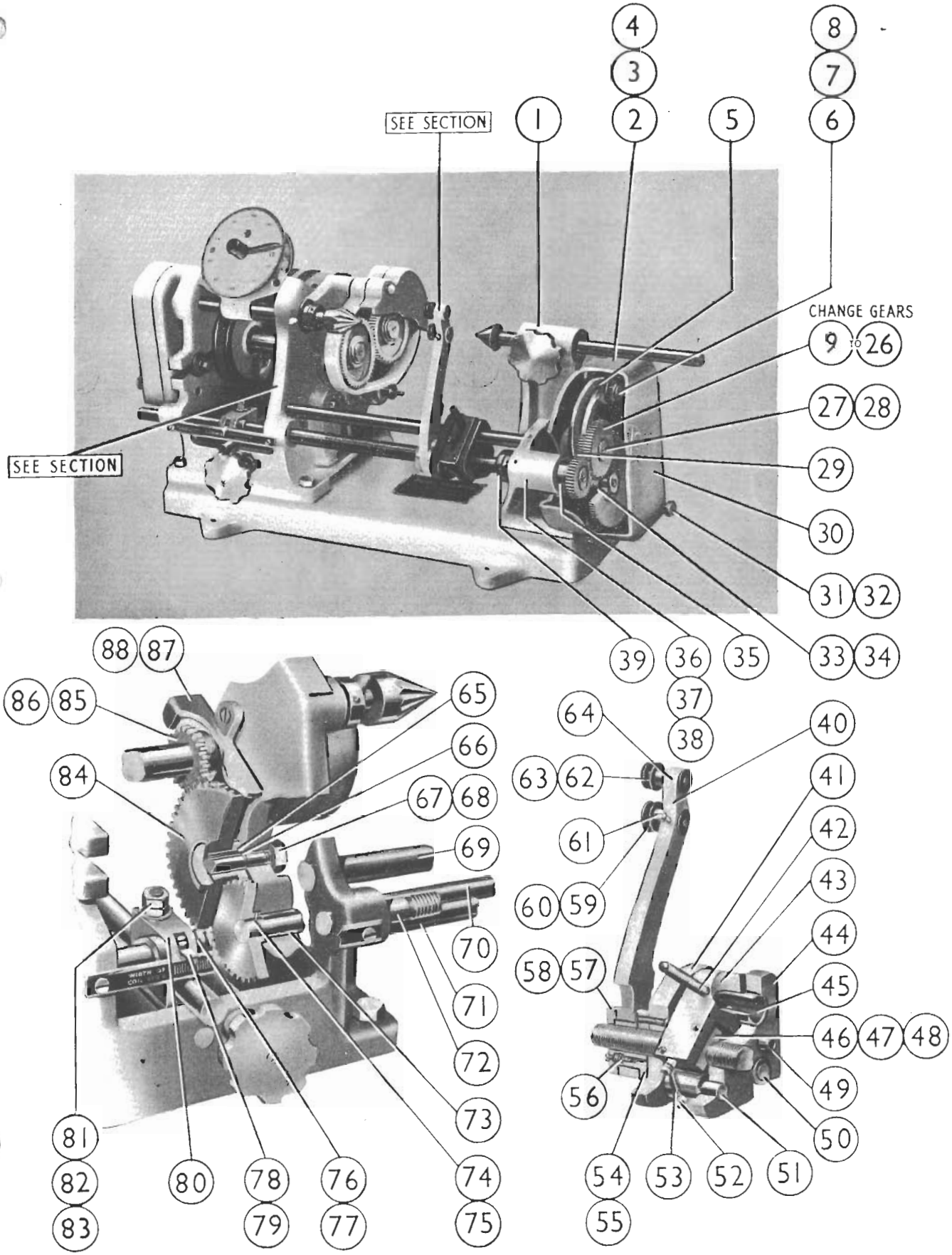
THESE MAY BE PURCHASED FROM THE COMPANY.

Plate 6—Parts List

ITEM NO.	DESCRIPTION	PART NO.	NO. OFF
1	Tailstock Casting	40360/3	1
2	Fixed Traverse Gear Guard	40285/3	1
3	Screw Securing Item 2.	AS.21	1
4	Screw Securing Item 2.	AS.18	1
5	Gear Quadrant Complete with Stud	13577/A	1
6	Gear Quadrant Spindle	13126/1	1
7	Washer for Item 6	W.23	1
8	Nut for Item 6.	N.30	1
9	Traverse Change Gear, 28 teeth	30018/4	1
10	Traverse Change Gear, 30 teeth	30018/6	2
11	Traverse Change Gear, 32 teeth	30018/9	1
12	Traverse Change Gear, 34 teeth	30018/10	1
13	Traverse Change Gear, 36 teeth	30018/13	1
14	Traverse Change Gear, 38 teeth	30018/16	1
15	Traverse Change Gear, 40 teeth	30018/19	1
16	Traverse Change Gear, 42 teeth	30018/22	1
17	Traverse Change Gear, 44 teeth	30018/24	1
18	Traverse Change Gear, 46 teeth	30018/27	1
19	Traverse Change Gear, 48 teeth	30018/29	1
20	Traverse Change Gear, 50 teeth	30018/31	1
21	Traverse Change Gear, 55 teeth	30018/33	1
22	Traverse Change Gear, 60 teeth	30018/35	1
23	Traverse Change Gear, 65 teeth	30018/37	1
24	Traverse Change Gear, 70 teeth	30018/39	1
25	Traverse Change Gear, 75 teeth	30018/43	1
26	Traverse Change Gear, 80 teeth	30018/45	1
27	Special Washer for Change Gears	10586/1	3
28	Screws Securing Change Gears	S.224	3
29	Idler Assembly	10831/B	1
30	Traverse Gear Guard Cover	40286/3	1
31	Studs for Gear Guard	13295/2	2
32	Terminal Nuts for Item 31.	11473/2	2
33	Gear Collet	13125/2	1
34	Pin Securing Item 33	20339/22	1
35	Bush and Gear Collet Combined	13578/A	1
36	Bearing Support Bracket	13299/2	1
37	Screws Securing Item 36	AS.46	2
38	Dowels Locating Item 36	20339/9	2
39	Clamping Nuts	13301/2	2
40	Wire Guide Arm	13326/2	1
41	Arm Carrier Plate	13307/2	1
42	Release Stud	13317/2	1
43	Half Nut Arm complete with Spring Post and Stop Screw	14159/A	1
44	Half Nut Arm Plate	13309/2	1
45	Spacing Bush	13306/1	1
46	Half Nut	14276/1	1
47	Screws Securing Item 46	AS.5	2
48	Dowels for Item 46	20339/14	2
49	Clamping Screw	AS.40	1
50	Bottom Spacing Bush	13306/2	1
51	Spacing Pillar	13563/2	1
52	Spring Anchor Post	13314/2	1
53	Half Nut Arm Spring	11908/1	1
54	Bush for Wire Guide Arm	13303/1	1
55	Screws Securing Item 54	S.456	3
56	Springs for Wire Guide Arm	13549/1	3
57	Wire Guide Arm Washer	13550/1	1
58	Screws Securing Item 57	S.669	3
59	Wire Guide Stud for Progressive Wave Winding	13254/2	1
60	Wire Guide Stud for Pie Type Winding	12174/1	1
61	Screw Securing Item 59 or 60	S.449	1
62	Wire Guide Pulley	12200/1	1
63	Shoulder Screw for Item 62	12210/1	1
64	Complete Carriage Assembly including Wire Guide Arm	20721/A	1
65	16 teeth Gear	13120/1	1
66	Bush	13304/1	1
67	Gear Stud	13294/2	1
68	Nut for Item 67	N.28	1
69	Top Guide Rod	20660/1	1
70	Traverse Gear Driving Shaft	20625/1	1
71	Bottom Guide Rod	20666/2	1
72	Lead Screw	20659/1	1
73	Reservoil Bush	11658/10	1
74	48 teeth Gear	13118/1	1
75	Pin Securing Item 74	20339/22	1
76	Collars Retaining Item 80	13305/2	2
77	Pins Securing Item 76	R.27	2
78	Pointer	13325/2	1
79	Screw Securing Item 78	S.463	1
80	Clamping Piece	13269/2	1
81	Eye Bolt	13296/2	1
82	Washer for Item 81.	W.21	1
83	Lock Nuts for Item 81.	N.27	2
84	75 teeth Gear	13119/2	1
85	27 teeth Gear	13111/1	1
86	Pin Securing Item 85	20339/22	1
87	Internal Gear Guard	13337/3	1
88	Screws Securing Item 87	S.230	2

FOR ALL OTHER ITEMS NOT SHOWN, SEE PLATES 1 AND 2.

PLATE 6 "DOUGLAS" PROGRESSIVE WAVE WINDER



OTHER MACHINES IN THE "AVO" RANGE

"DOUGLAS" NO. 6
"DOUGLAS" NO. 1
"DOUGLAS" NO. 3
"MACADIE" S.C.
"MACADIE" T.D.S.M.
"DOUGLAS" NO. 15
"MACADIE" FULLY AUTOMATIC P.I
"DOUGLAS" NO. 3 EXTENDED BASE
"DOUGLAS" LARGE MULTI WINDER
"DOUGLAS" SMALL MULTI WINDER
"DOUGLAS" DUAL HEAD
"DOUGLAS" MAGNETO
"DOUGLAS" SPECIAL EXTENDED BASE NO. 6
"DOUGLAS" SPIRAL
"DOUGLAS" COTTON INSERTER
"DOUGLAS" NO. 7 TAPING MACHINE
"DOUGLAS" NO. 8 TAPING MACHINE
"DOUGLAS" NO. 9 TAPING MACHINE
"DOUGLAS" NO. 10 TAPING MACHINE
"DOUGLAS" NO. 11 TAPING MACHINE
"DOUGLAS" NO. 12 TAPING MACHINE
"DOUGLAS" HEAVY DUTY POWER DRIVEN
"DOUGLAS" HEAVY DUTY H.F.

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