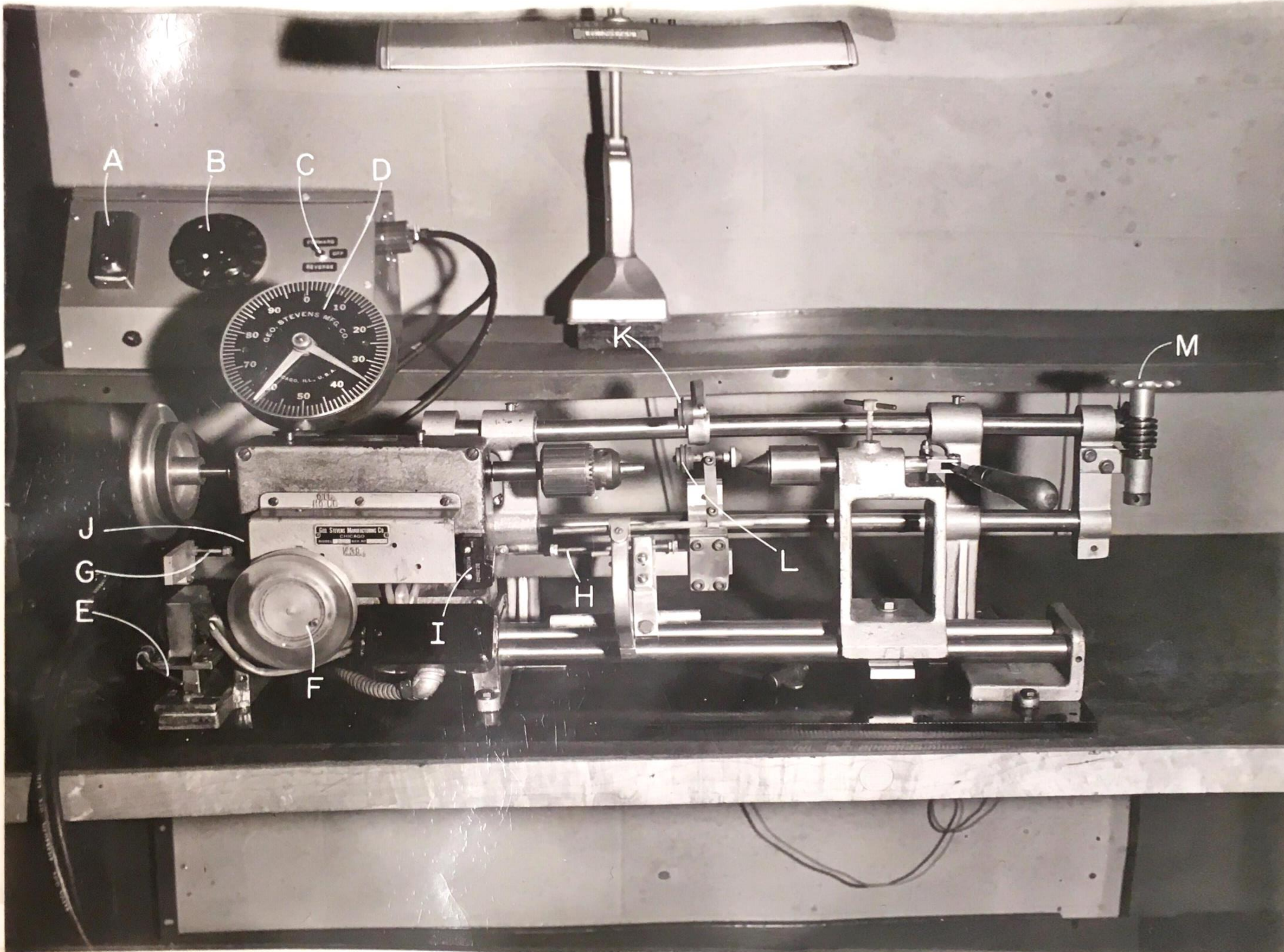

A
B
C
D
FORWARD
OFF
REVERSE
GEO. STEVENS MFG. CO.
CHICAGO, ILL., U.S.A.
GEO. STEVENS MANUFACTURING CO.
CHICAGO
E
F
G
H
I
J
K
L
M

GEORGE STEVENS Mfg. Co. Inc.
6022-T N. Stevens Ave.
Chicago, IL 60646
Phone: 312-588-1300

Model 37
Serial No. 5437

OPERATING INSTRUCTIONS
STAFF SHOP COIL WINDER

The small coil winder shown in the photograph is available for general use. All users are expected to study these instructions and use reasonable care in operating it. If for any reason the equipment is damaged or malfunctions, please report it immediately so that necessary repairs can be made.

Because of past difficulties with maintenance, the machine and its accessories are kept locked. Keys may be obtained from any of the following staff members:

A. C. Anderson
D. M. Ginsberg
J. M. Mochel
D. E. Mapother
C. B. Satterthwaite

Lock up the equipment and return the keys after each use.

Keyed items in the photograph are listed below with brief explanatory comments.

A = Power switch. Key required to operate.

B = Variac speed control. As explained below this is one of two available modes of speed control.

C = Spindle reverse switch. Controls sense of winding.

D = Turns counter. May be reset to zero.

E = Power feed disconnect (shown engaged). When raised to the vertical position, handle E disengages and locks the automatic feed reverse. This permits manual movement of the feed traverse by means of hand wheel, F.

F = Hand feed wheel

G = Right hand margin adjustment. Coarse and fine adjustments control

H = Left hand margin adjustment. the point at which power feed reverses for automatic winding of multilayer coils. These adjustments must be carefully set (usually by trial and error) in order to obtain neat and accurate margins on multilayer coils. Poor adjustment is indicated by piling up or voids in the windings near the margins.

I = Left hand end feed reverse micro-switch

J = Right hand end feed reverse micro-switch

K = Rear wire guide pulley. Thread wire from tension-dereeler over

L = Front wire guide pulley. pulley K and then pulley L. These two pulleys serve to position the wire accurately with respect to the feed traverse. Pulley L should be positioned close to the coil form for good tracking. See schematic diagram in Fig. 1. The bracket which carries pulley L is shown clamped to the rack of the feed drive. It can also be clamped to the same rod as the support for pulley K if this is more convenient.

M = Height adjusting control for wire guide pulley K.

Not shown in the photograph is an optional speed control device operated by a foot pedal. A cord from the foot pedal plugs into the right side of the control box. A selector switch below C (not shown in the photograph) must be thrown to the proper position to choose (1) Variac controlled operation or (2) foot controlled operation. Foot controlled operation is helpful when the winding job involves frequent stops.

This coil winder and its associated equipment are intended for automatic winding of multilayer coils of fine wire (30 gauge wire and smaller diameters). Assuming the operator has become familiar with the mechanical operation of the coil winder, the following additional points must be considered.

1. Tension-Dereeler Several units are available in the parts cabinet. The choice depends on the size of wire to be handled. Place the wire spool in the chosen dereeler and thread the loose end through all guides and pulleys. The dereeler should be placed on the back shelf next to the light base.

2. Winding Pitch The pitch of a winding gives the distance between successive turns. (See Fig. 2a). The value is determined by the automatic feed of the coil winder and is adjustable by changing gears on the back of the headstock of the machine.

The user must first decide what pitch is required for his coil. The choice of pitch has been studied empirically by systematic experiments using different pitches. If the wire diameter (including insulation) is d and the pitch is p, we may define a dimensionless ratio,

$$R \equiv \frac{p}{d} .$$

Experiments show that the most uniform packing in a random wound* multilayer coil occurs for values of R such that

$$3 < R < 15 .$$

Values of R beyond these limits give windings of non-uniform density. The most uniform density occurs near the midpoint of the range (i.e. $R \simeq 8$) but acceptable uniformity is obtained throughout the range.

The average coil density may be described by the ratio

$$S \equiv \rho/\rho_i$$

where ρ is the actual number of turns per unit of winding cross-section and ρ_i is the corresponding winding density for a geometrically perfect coil. Geometrical perfection refers to a close packed winding with p = d for each layer. (See Fig. 2b)

Within the range of uniform winding density, the actual density increases with decreasing pitch as indicated by the values below:

R	S
15	0.56 ± 0.008
8	0.59 ± 0.008
3	0.63 ± 0.019

Thus the best compromise between maximum density and uniformity occurs for a random wound coil such that $p \simeq 3d$. At this pitch, the actual winding density is 63% that of a geometrically perfect coil. It is noteworthy that the actual winding density does not vary strongly with pitch within the favorable range.

The experiments from which the foregoing results were obtained were done with 40 gauge, heavy formex insulated copper wire. Subsequent experience

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* The term, random wound, is applied to a coil wound using the automatic feed and margin reverse. Even though the automatic feed distributes the wire uniformly, the packing of individual turns within the winding is random. As will be explained later, this is the most practical mode of winding if many layers of turns are required.

indicates that the conclusions can be scaled to other wire sizes by working with the dimensionless ratio R.

All conclusions so far assume that the winding is laid down in an automatic way using the full mechanical capabilities of the coil winder. This, of course, is what the machine was designed to do and it is by far the most rapid way of winding a coil. However we also see that a random wound coil cannot exceed 63% of the density of a close packed coil. This raises the question of what to do if larger winding densities are desired.

Briefly, the answer is that higher densities require hand placement of each turn, a very tedious process. It is feasible to wind a coil of 2 or 3 layers with $p \simeq d$ to approach ideal close packing but careful and continuous inspection is required to avoid or correct misplaced turns. The problem is simply that manufacturing tolerances on commercial wire and the limits of human patience inevitably introduce winding imperfections. Such imperfections become more exagerated with each succeeding layer until a very lumpy looking coil results. Unless the required number of turns can be achieved in 2 or 3 layers, automatic random winding is the better method.

Part of the problem of winding close packed coils is the fact that the direction of the helix described by the wire reverses on each layer. Each new layer must lie over the grooves formed in the previous layer which are advancing in the opposite sense. One solution to this problem is to insert a layer of paper, mylar, or some other sheet insulation over each completed layer. This gives a new smooth cylindrical surface for the new layer. The use of layer insulation has two disadvantages:

a) It is tedious and difficult to insert and hold the layer insulation.

b) With small wire diameters, substantial volume is occupied by the layer insulation.

3. <u>Changing Gears</u> Changes in winding pitch require replacement of gears in the gear train on the back of the headstock. A picture of the change gears is shown on the sheet which tabulates pitch vs tooth number.

The gears are held on their shafts by hex nuts. A box wrench of correct size for these nuts is available (and should be used instead of an adjustable wrench). Use care in removing and remounting gears. Do not over-tighten the retaining nuts and be sure that all gear teeth mesh properly.

TURN THE SPINDLE BY HAND TO CHECK GEAR TRAIN ENGAGEMENT BEFORE USING THE MOTOR DRIVE.

4. Margin Adjustment Direction of wire feed advance is controlled by a solenoid operated clutch. The margin stops, G and H, trip microswitches which activate one of the two opposing solenoids to reverse feed direction. The trip points are accurately repeatable and serve to define the margins of the coil winding.

These trip points can be set to occur at any position within the range of travel of the wire feed. Both stops G and H may be positioned roughly by means of the screw clamps which hold them to the feed drive bar. Fine adjustment of either stop is done with the screws which touch the micro-switches.

When adjusting the margin stops it is convenient to disengage the power feed by raising lever E. This permits easy displacement of the feed carriage back and forth by means of the hand feed, F. Don't forget to re-engage the power feed by lowering lever E after margin adjustment is completed.

CAUTION: Under normal power driven operation the microswitches reverse the feed direction when depressed by the margin stops. If the margin stops strike a microswitch when the automatic reversing action has been defeated, the impact can destroy the microswitch. This can occur in two ways:

1. With power off and the solenoid clutch disengaged, over-zealous movement of the handwheel, F, can crunch a microswitch.
2. With power off, if the spindle is turned by hand with power feed engaged, the margin stop can crunch a microswitch.

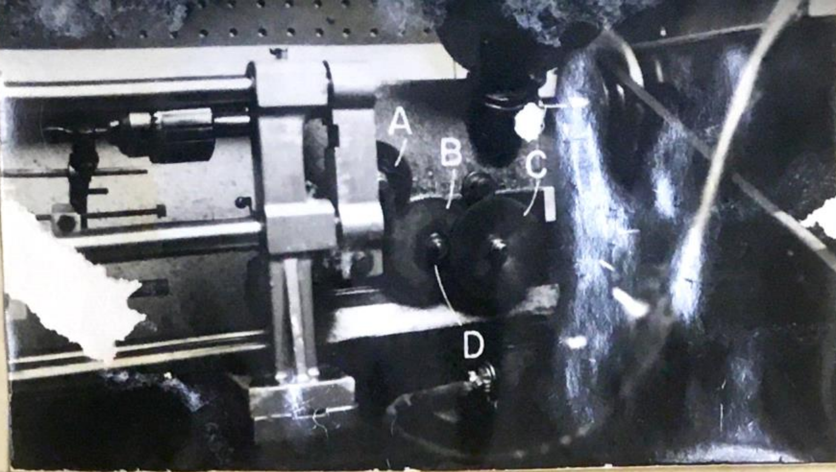
Power to the solenoids is on whenever the pilot light below the Variac dial is lit. To avoid damage to the microswitches do not attempt manual motion of the feed mechanism unless solenoid power is on. If this precaution is observed one can at least hear when a microswitch has been depressed by the noise of the solenoid. Despite all precautions, accidents sometimes occur. If you manage to break a microswitch PLEASE REPORT IT so the equipment can be repaired immediately.

5. <u>Mounting Coil Bobbins</u> A Jacobs chuck and live center are available for holding coil forms or other fixtures. The usual method is to mount the coil form on a mandrel which the user prepares to hold his particular coil. Details will vary with the size and shape of the desired coil. ~~Since~~ Some typical methods are illustrated in Figs. 3 and 4.

Two points should be remembered when designing a mounting:

a) The coil bobbin must be securely locked to the spindle drive to maintain wire tension and give a correct count. Avoid marginal friction drives. Its very disheartening to have a 10,000 turn coil start slipping after 8,000 turns.

b) A finished coil is a rather delicate item. Plan ahead to anticipate problems which may arise when it comes time to remove the finished coil from the machine.



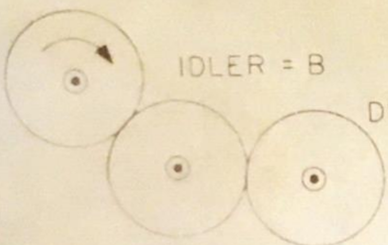
115
47
90

1:1 IDLER

DRIVER = A

IDLER = B

DRIVEN = C



$\frac{TPI}{32}$ x DRIVER = DRIVEN

DRIVEN GEAR FOR THIS CHART = 100 TEETH

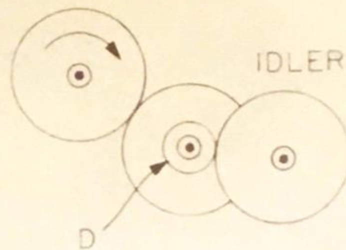
MAY BE CHANGED FOR OTHER COMBINATIONS

4:1 IDLER

DRIVER = A

IDLER = B

DRIVEN = C



$\frac{TPI}{128}$ x DRIVER = DRIVEN

DRIVEN GEAR FOR THIS CHART = 100 TEETH

MAY BE CHANGED FOR OTHER COMBINATIONS

TURNS PER INCH	DRIVER TEETH	TURNS PER INCH	DRIVER TEETH	TURNS PER INCH	DRIVER TEETH	TURNS PER INCH	DRIVER TEETH	TURNS PER INCH	DRIVER TEETH	TURNS PER INCH	DRIVER TEETH
32	100	43.2	74	66.6	48	128.0	100	173.0	74	266.7	48
32.7	98	44.4	72	69.6	46	130.6	98	177.8	72	278.3	46
33.3	96	45.7	70	72.7	44	133.3	96	182.9	70	290.9	44
34	94	47	68	76.2	42	136.2	94	188.2	68	304.8	42
34.8	92	48.5	66	80.0	40	139.1	92	193.9	66	320	40
35.6	90	50	64	84.2	38	142.2	90	200	64	336.8	38
36.4	88	51.6	62	88.9	36	145.5	88	206.5	62	355.6	36
37.2	86	53.3	60	94.1	34	148.8	86	213.3	60	376.5	34
38	84	55.2	58	100.0	32	152.4	84	220.7	58	400	32
39	82	57.1	56	106.7	30	156	82	228.6	56	426.7	30
40	80	59.3	54	114.3	28	160	80	237	54	457.1	28
41	78	61.5	52	123	26	164.1	78	246.2	52	492.3	26
42.1	76	64	50	133.3	24	168.4	76	256	50	533.3	24
42.7	75					170.7	75				

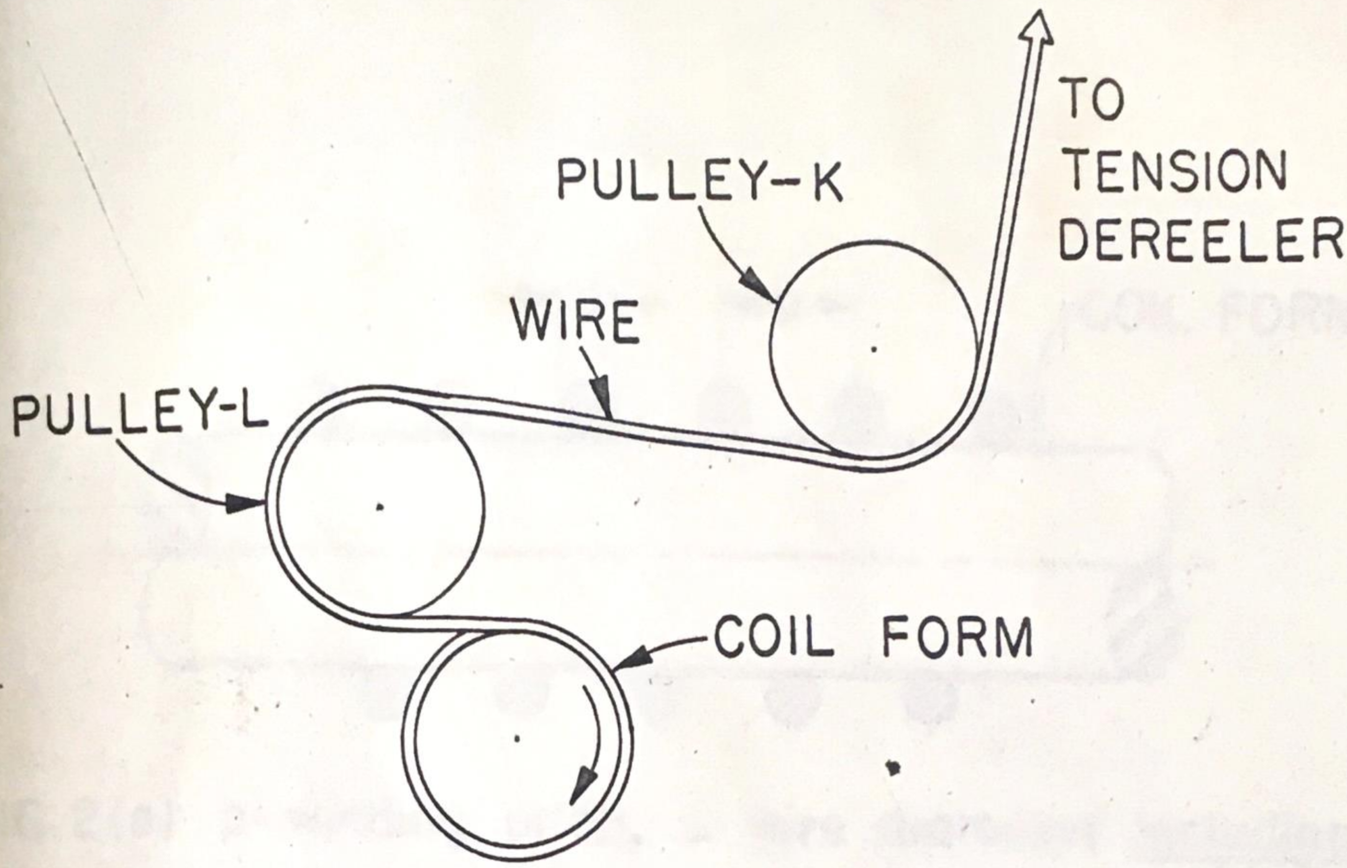


FIG. I. DIAGRAM FOR THREADING WIRE FEED.

ARRANGEMENT SHOWN IS TYPICAL BUT

CAN BE VARIED TO SUIT CONVENIENCE.

For best tracking, the segment of wire between pulley L and the coil form should be kept small.

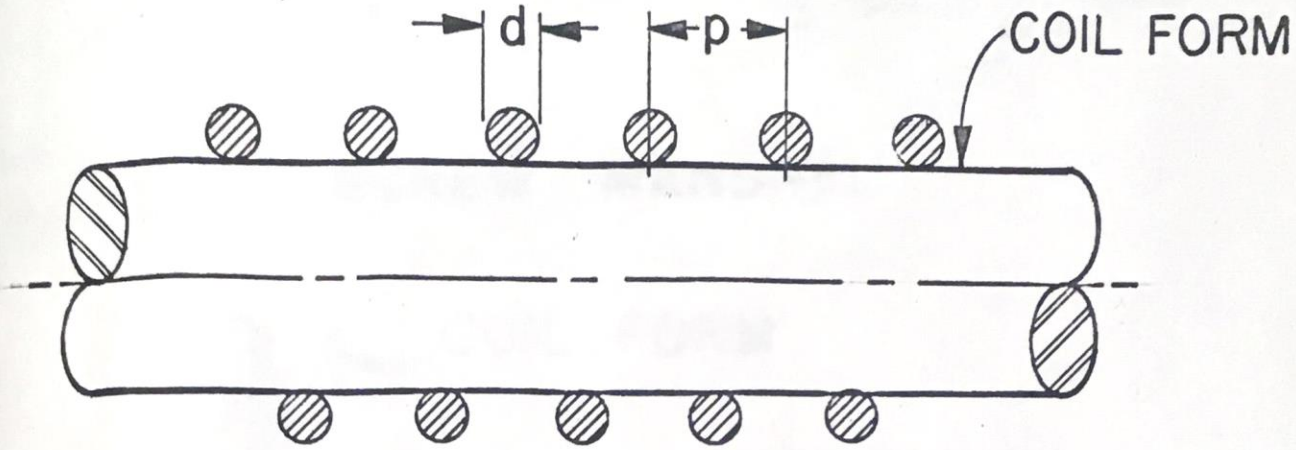


FIG. 2(a) p = winding pitch, d = wire diameter including insulation.

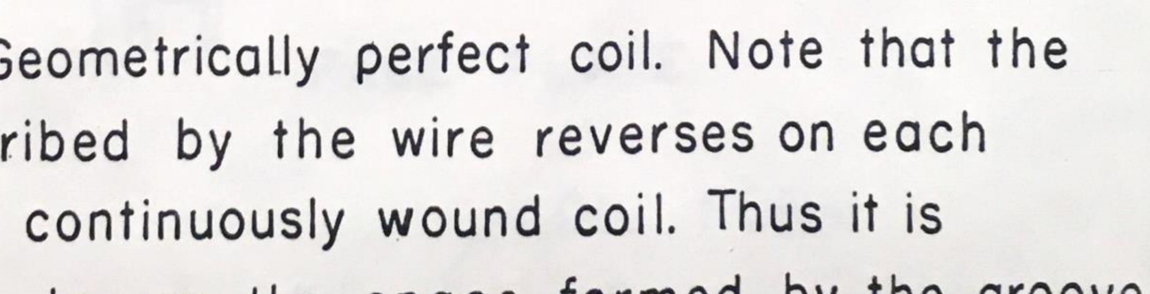
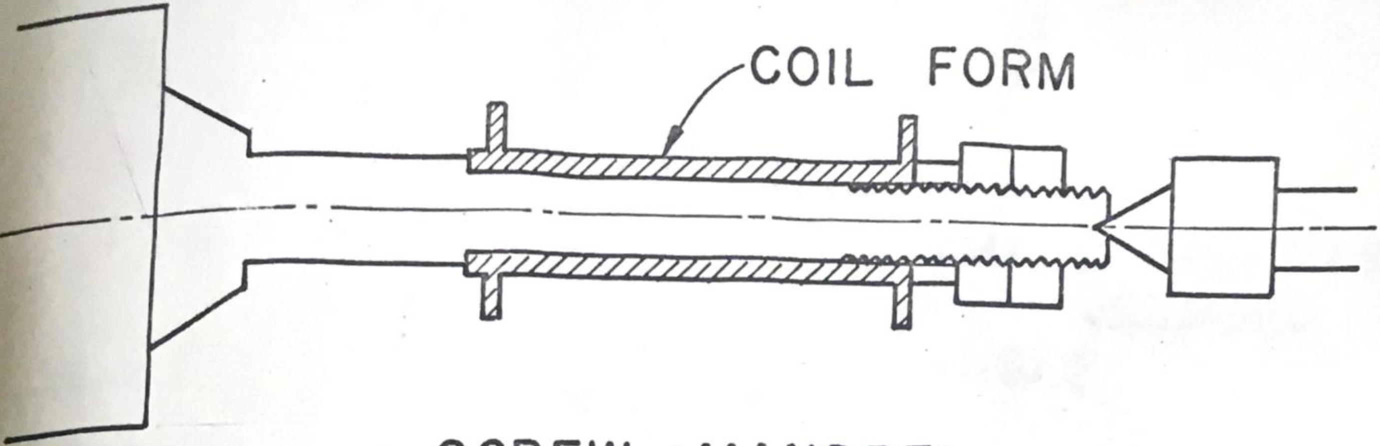


FIG. 2(b) Geometrically perfect coil. Note that the helix described by the wire reverses on each layer in a continuously wound coil. Thus it is impossible to use the space formed by the groove between consecutive turns.



SCREW MANDREL

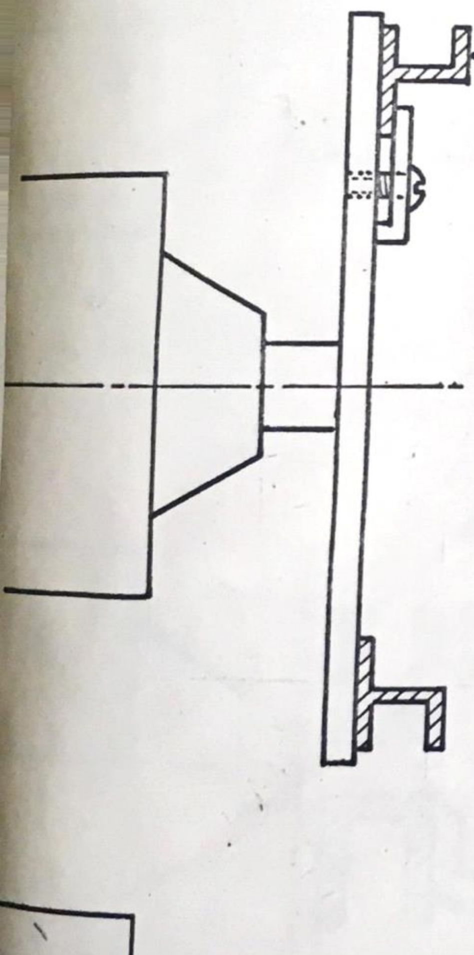
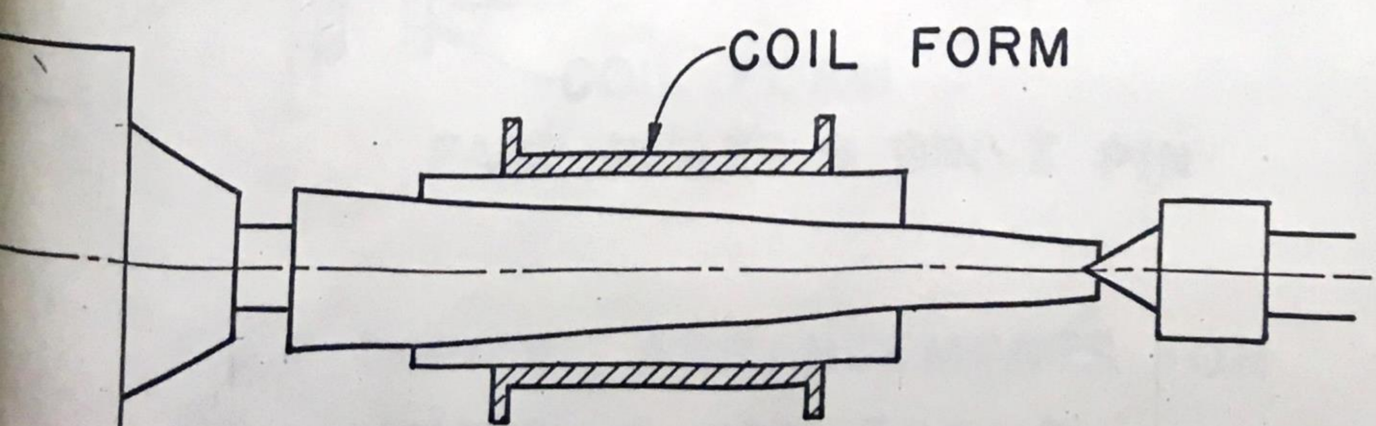
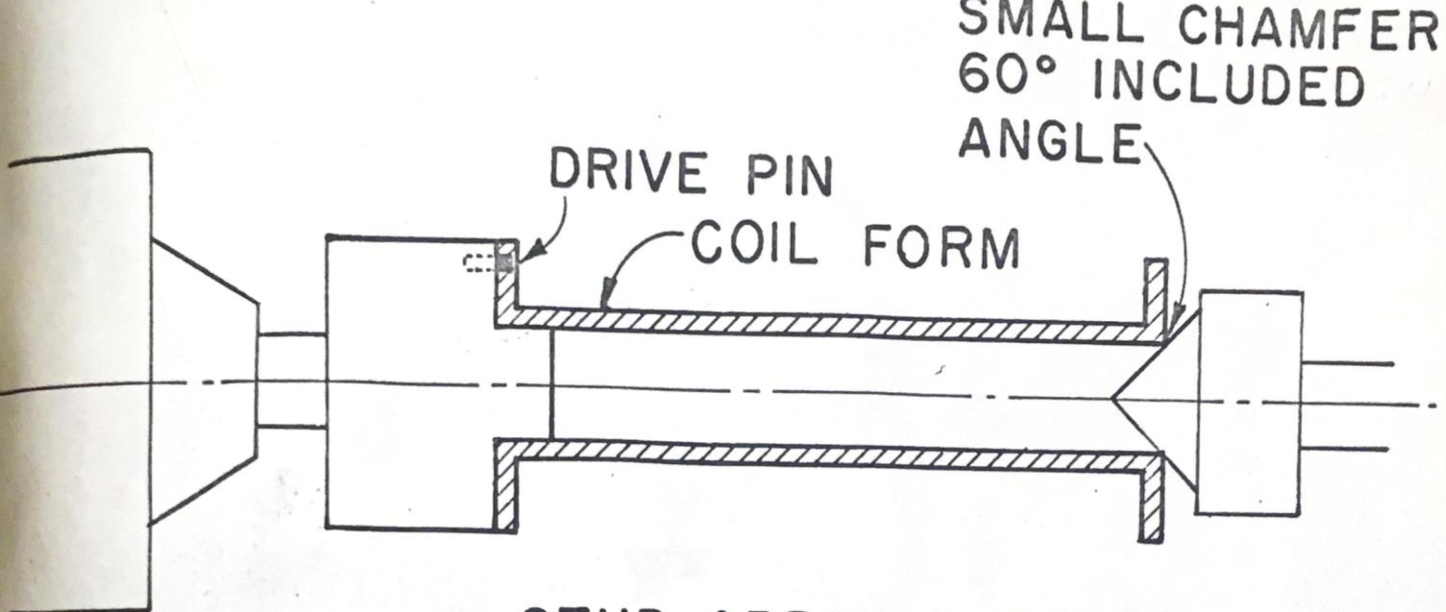


FIG. 3 TYPICAL ARRANGEMENTS FOR MOUNTING COIL FORMS

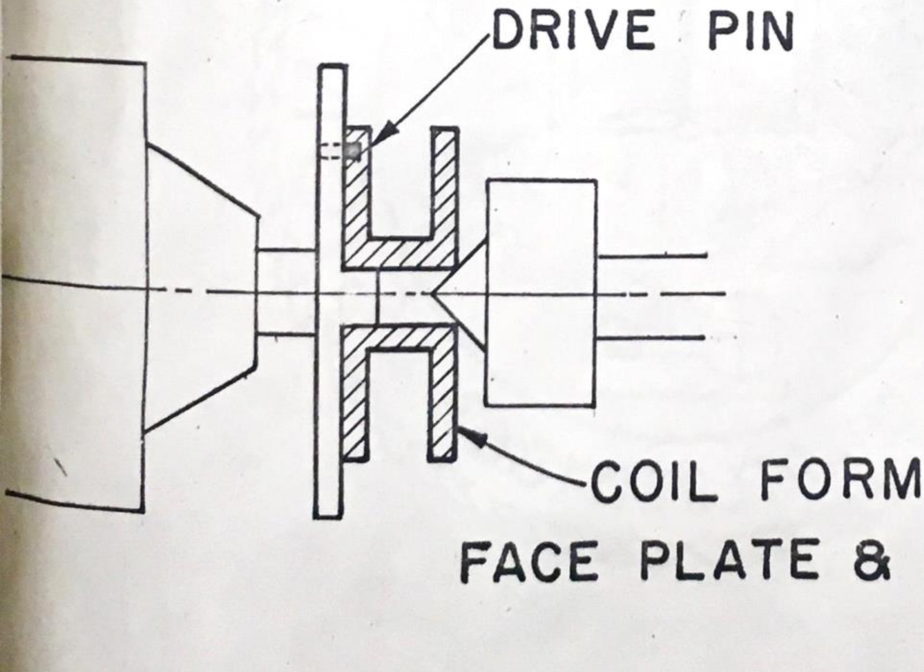
FACE PLATE



EXPANDING MANDREL



STUB ARBOR & DRIVE PIN



FACE PLATE & DRIVE PIN

FIG 4 TYPICAL ARRANGEMENTS FOR MOUNTING COIL FORMS

Coil Winder Data

3/7/83

	closest packed		random wound		
Size	TPI (no ins.)	TPI (ins)	Max TPI	min TPI	# choices
10	318	247	82	16	8
39	283	226	75	15	7
38	252	206	69	14	7
37	225	187	62	12	8
36	200	169	56	11	7
35	178	153	51	10	7
34	159	139	46	9	6
33	141	125	42	8	7
32	126	113	38	8	5
31	112	102	34	7	5
30	100	91	30	6	5
29	89	82	27	5	5
28	79	74	25	5	5
27	70	66	22	4	4
26	63	59	20	4	3
25	56	53	18	4	3
24	50.	47	16	3	2
3	44	42	14	3	2
2	39	38	13	3	2
0	31	30	10	2	1
[illegible]	28	27	9	2	1
3	25	24	8	2	1

TPI (Ratios) Available
8.3
13
16.7
20.4
25.0
39
~~31.3 30.4~~
40.9
50.1
61.3
78
122.7
235

ins = no insulation

= 1mil insulation

= turns per inch (range given is suitable for random winding)