

**JULY 69**

# **circuits manufacturing**

**Electronic Manufacturing Exposition & Conference New York Hilton September 16, 17, & 18**

**COVER STORY**

**coil winding**

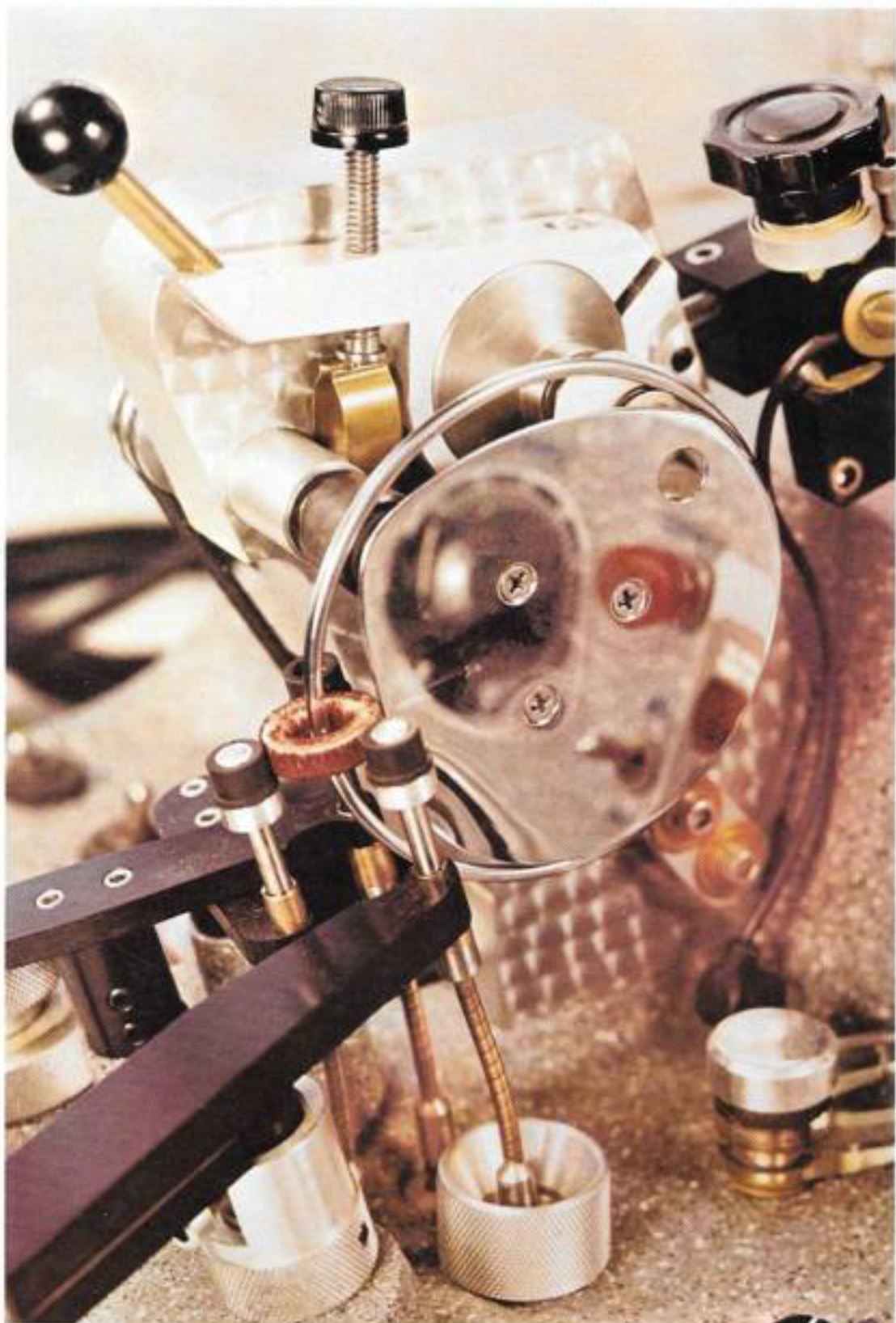
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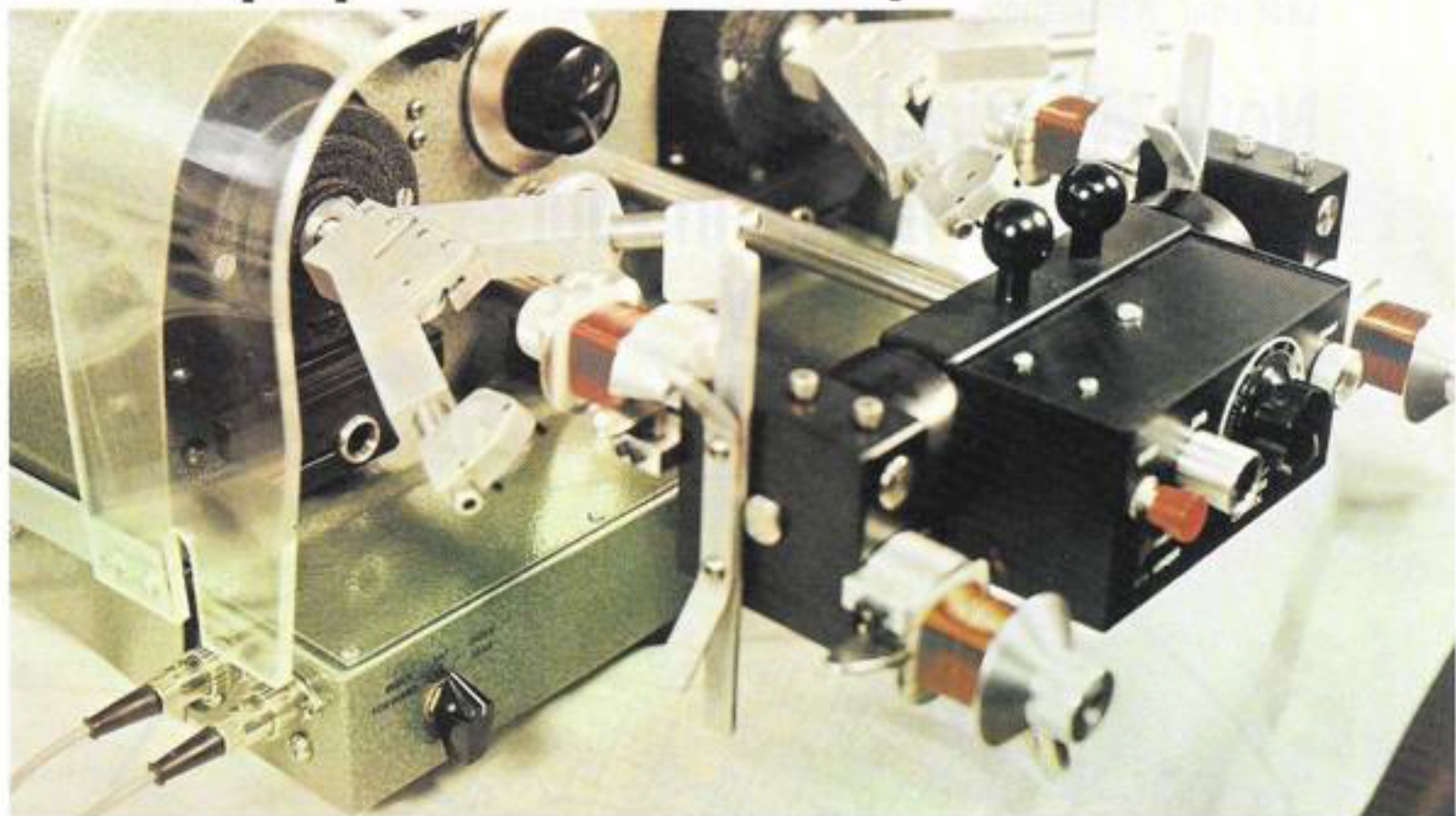
**MAKING GOOD SOLDER JOINTS . . . 58**



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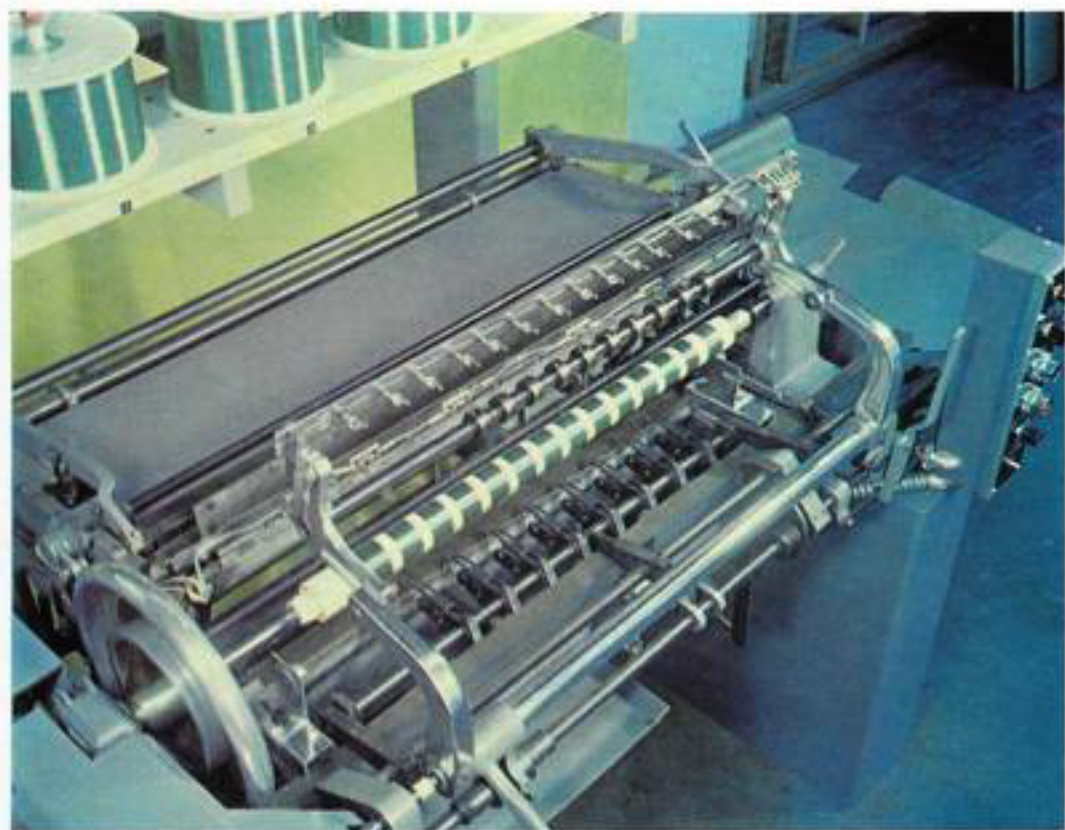
# assembly & production machinery



Dual head spin winder handles bobbins up to 3" in dia and 2-1/4" long. Gorman Machine Corp.

## COIL WINDERS a state-of-the-art survey

Miniaturization is here to stay. Coil manufacturers must wind finer gage wires into smaller coils in ever increasing quantities. Producing satisfactory coils at low cost becomes more difficult. New coil designs call for more elaborate configurations and demand that winding machine manufacturers offer not only more versatile machines but also attachments and new equipment to tackle the problem of microminiaturization.



Strap-type, felt-lined unrolling tensions allow winding wire sizes from #19 down to #42. Leeson Corp.

Coil manufacturers must produce not only newer and smaller types of coils, but also more prosaic ones. However, competition demands manufacturing these standard coils at lower cost. Lower prices can also hold back the adoption of usurping devices.

Some specific problems encountered in coil manufacturing are:

- The need for coils to meet rigid specifications such as resistance and inductance.
- Lead accuracy in winding individual turns to determine the uniformity of the magnetic field generated by the coil.
- Properly placing insulation or eliminating nicks on wire surface coatings to prevent shorts and breakdown.
- Carefully maintaining tension to prevent mechanical difficulties arising from shock and vibration.





George King  
West Coast Editor

- The need for coil to coil uniformity for some critical applications to match within a very close tolerance.

Although not complete, this short list does summarize the major problems coil manufacturers may encounter. To manufacture coils at lower cost, the operator must use the latest and fastest machinery, some of which we describe herein. If you are unfamiliar with the type of machinery we discuss, we recommend the third edition of "Coil Winding", by Wm. Querfurth, published by Geo. Stevens Mfg. Co., Inc. (see address in Buyer's Guide). Often called the "bible" of the industry, the book costs \$6.75.

### important developments

In the last 5 years, the most important developments other than the steady march toward micro-miniaturization have been spin winding's return to favor and the development of "perfect" layer coil winding. Although neither development equals the momentousness of, say, a truly shuttleless toroidal coil winder, each constitutes an important contribution to the state-of-the-art.

In spin winding, the bobbin, coil form or mandrel remains stationary. A spinning arm revolves concentrically about the bobbin and simultaneously traverses back and forth to lay the wire in its appropriate pattern. Manufacturers differ in the arrangement they have built into their equipment. For example, in Gorman Machine's winders, the wire to be wound runs through the hollow stationary shaft that holds the bobbin; in Leeson's and Coweco's, the wire runs through the hollow live spindle of the spinning arm (or flier, in the textile world).

Why has spin coil winding become important again? High production requirements and cost reduction have both contributed to its resurgence. The technique lends itself to automation more easily than the standard lathe-type set-up. Winding large numbers of coils in the rotating coil machines usually requires mounting the bobbins on a common mandrel and winding all the coils together. If

the wire to any coil breaks during winding, that whole part of the operation shuts down; if no trouble occurs, the operator removes the stick of coils after taping and inserts a new stick. She then attaches the wire to each bobbin and starts the machine. While the machine winds the coils, she removes the bobbins from the mandrel and replaces them with empty ones. And so the cycle continues. The machine is idle for a relatively large percentage of the production time.

High production spin winders, on the other hand, generally come equipped with two or more stations. At a two-station machine, the operator, after cutting and taping, unloads the finished coil while the machine winds the coil at the second station. In a machine with more stations, the equipment may wind more than one coil at a time or accommodate more than one operator to cut production time.

Spin winding enables winding coil configurations such as horseshoe stack laminations at high production rates. Since the coil does not rotate during winding, spin winding machines can wind unbalanced forms at speeds comparable to any other.

"Perfect" layer coils, also known as orthocyclic (Fig 1), occupy minimum space and thus approach the ultimate in winding perfection. Since they occupy the least space, they save copper - 10 to 20% - in transformer windings, for which they find most widespread use. Therefore, perfect layer coils are most commonly wound as square or rectangular to fit laminated stacks. Coil uniformity results in optimum electrical characteristics.

What are "perfect" layer coils? A description of a rectangular-shaped perfect coil is easiest to understand. Think of winding the wire on a rectangular mandrel. By winding the wire on three of the four plane surfaces without any lead and ensuring that the required lead occurs only on the fourth side at each complete turn, you can wind a coil with minimum copper. And if you go one step further, as does Eubanks Engineering, and use mandrels with shallow grooves accurately spaced to the wire's nominal dimension (the center of the wire's diametric tolerance), you can wind (given the proper equipment) coils with the absolute minimum of wire. A perfect layer coil is easy to spot; a look at either face reveals a pattern on only one of the 4 legs.

The type of coil to be wound

determines the basic type of machine required to wind it. Neglecting armature and stator coils, most coil forms divide roughly into two categories: coils wound around a straight longitudinal axis and coils wound around a closed circular or ring axis. Machines to wind the straight-axis coils are called lathe-type and those for ring-axis coils, toroid-type. Lathe-type winders include coil rotating and spin winding equipment. This class contains the greatest variety of models.

From manufacturer's literature, we culled descriptions of the equipment which we bring to your attention here. Table I classifies available machinery by the types of coils they wind. Under each coil type we list equipment according to three categories of quantity - prototype, medium and large. Some manufacturers provide special machines for making prototypes or limited numbers only. Others make machines only for medium and large volume production.

### lathe-type winders

Assoc. American Winding Machinery (Amacoil) distributes rather than manufactures a large range of coil making machines made in Europe and coil turns analyzers (including an automatic unit) made by Wabash Magnetics, Inc., in the U.S. Amacoil's line covers all the coils listed in the chart except toroids.

The Amacoil line of equipment consists of machines small enough to handle the smallest size coils and wire



Coil winder operates up to 2500 rpm, accepts up to 15 inserts per minute. Leeson Corp.



as fine as 0.0004", and machines so large that they can coil 0.5" wire to a 59.5" OD. Some of the machines have only a single spindle, others have two; some can wind multiple coils on their spindles and interleave the coil layers with insulation. The company sells completely automatic turret-type machines which the user tends only by overseeing operation. The operator loads bobbins into a vibrating hopper and keeps the wire de-reelers filled. Depending on the number of turns on each coil, the production rate can reach as high as 900 per hour. These high production rate machines use the spin winding technique. For winding orthocyclic or perfect layer coils, Amacoil sells 2 models: MD 60 and MD 65 wind 0.016" to 0.059" wire on coils as wide as 2" x 6.9" OD, at winding speeds of 330, 620, 990 rpm.

Coil Winding Equipment Co. manufactures a series of machines to wind any type coil in Table I. (See page 31)

They also make spin winders with hand or automatically indexed turret attachments. Some of the machines come with hoppers to feed the coil

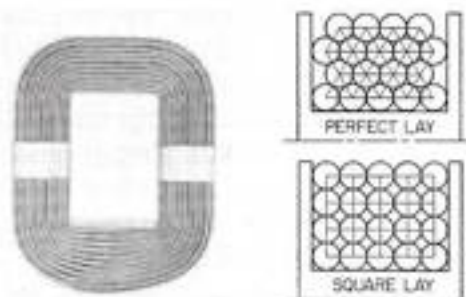


Fig 1 (a) Perfect layer coil shows up the crossover as a pattern of light on one leg only. (b) The perfect layer coil shows the triangular packing of the layers vs the square layer coil.

forms and equipment to strip the wire, cement and initial turns, cut the wire after the coil has finished winding and eject the coil automatically.

Elden Manufacturing Co. produces a line of bobbin winders as bench top assemblies in single units or side-by-side multiples. The company also makes a 5-ft diameter indexing turntable upon which are assembled six bobbin winders positioned sequentially in front of the operator, with the wound coil to be replaced by an

empty bobbin. Station to station index takes 3.5 seconds.

Like many equipment manufacturers, Elden also makes a spin winder, which has a 6-station turret and options such as an automatic waxer (cement), wire cutter and coil ejector.

Eubanks Engineering manufactures coil winders (Fig 2) which the operator programs. Then she sets up the machine from a data sheet, or when using the card controlled machine, places an IBM punched card into the card reader to automatically set all the machine functions. From either information source, the machine sets pitch, traverse length, winding speed, turns count (up to 5 tap points), spindle acceleration and deceleration pattern and wire tension. Eubanks claims a turns count accuracy within a 1/4 turn because the drive motor accelerates and decelerates so smoothly. The tension device is an eddy-current clutch with 99 points of adjustment. Electrically selected pitch in increments of 0.000018" per turn assure close matching to wire size.

A timing or cog belt drive, with electromagnetic clutches actuated by limit switches or a turns counter as

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Another Amacoil advance in automation — a horizontal turret winder that can be equipped with 4 decks and 2 (or more) winding heads, with 4 wire guides per winding head. The VA65 winds and finishes coils on four levels at the same time.

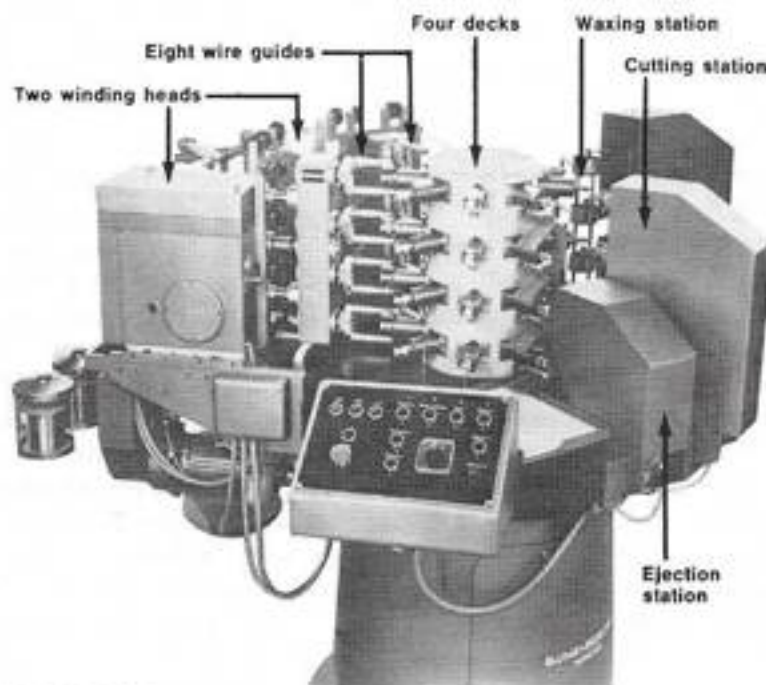
Standard options include the following:

- Automatic taping unit
- Automatic bonding unit
- Adjustable wire cutting unit
- Automatic ejection unit
- Additional operations can also be included.

Find out more about the *lowest winding costs ever* by just lifting the telephone now and calling Amacoil — the company with over 80 different types of modern coil winders on the market today.



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CIRCLE 17



desired, operates the traversing system. Traverse reverse occurs almost instantaneously without backlash at all winding speeds.

Model ACW-10A Types HPL-1 and -6 both wind perfect layer coils with all the machines' special functions electronically controlled to provide precise layer-to-layer advance at exactly the proper corner. These machines wind coils up to 5" OD x 5" long of 15 through 26 AWG wire.

*Excelsior's* winder has six cams and a vernier-controlled ratio selector to provide coil width and traverse speed for winding prototype bobbin coils. The lathe-type winder uses an SCR control for the motor.

*Gorman Machine's* production bobbin winders all come with one or more pairs of spin winding spindles. Thus, the operator finishes winding a coil and prepares the next while the machine is winding. An infinitely variable speed transmission eliminates gear changes for layering. Through use of an electronic counter to decelerate the drive system, the manufacturer claims to attain winding accuracy to one turn. The equipment can wind coils up to 3" OD, from 0.050" to 3-1/4" long from 22 to 50 AWG wire.

*Halm Instrument Co.* manufactures an automatic machine for high volume production of air wound coils from 0.062" to 0.128" wire in single or multilayer, simple or duplex with or without crossovers or multi-diameter in-line. After the machine pulls the wire from the reel through a tensioning and coating-stripping device, the wire runs to the feed and gripper head which feeds the leading end into the winding spindle after cutting off the preceding finished coil and forming the first end to the correct orientation. After winding and cut-off, the machine shapes the tail end and automatically ejects the coil.

*Innes Instrument's* machine is suitable for prototype jobs. Provided with an SCR-controlled motor with a speed range of 50 to 1000 rpm, the machine accepts round or square core bobbins from 3/16" to 1-1/4" up to 3" long and winds 20 to 48 AWG copper wire.

*Kahle Engineering*, over the last 38 years, has built primarily special purpose winding equipment for manufacturing grid filaments and lamp and tube coils. While Kahle does not make a standard bobbin winder, they do

produce special purpose winders such as a unit that attaches 19 to 26 AWG magnet wire to two terminals, winds 300 to 600 turns and wraps the coil



Fig 2 Lathe-type winder manufactured by Eubanks Engineering makes perfect layer coils. Note hysteresis tensioner for wire feed.

with thermosetting tape at production rates of 1000 to 2700 per hour.

*Leesona* offers Model 107 for paper interleaved coils to wind multiple coils on a single arbor. The machine has a short paper attachment for 1-3/8" minimum paper insert length with as many as 15 inserts per minute. Tension on the insert assures tight windings. The paper feed gearing staggers inserts to prevent overlap and

thereby eliminates egg shapes. A paper miss detector automatically stops the machine should a miss occur.

Multiples of the single spindle Model 115 Bacchi bobbin winder are spaced on a turntable to become Model 116. Each unit stops within two turns of the number required at speeds up to 12,500 rpm. The multi-head machine has a wire tension and breakage detector, an automatic taper for fastening the initial lead to the bobbin flange, a wire stripping attachment, an automatic finish taping attachment, an optional automatic waxing attachment and a wire cutter ejector with an automatic sorter which deflects coils of two different specifications into separate tote boxes.

*Leesona* also markets spin winders. One model comes equipped to do a specific job with a cam and gearing for making a specified coil. This unit has a horizontal axis-indexing bobbin turret. Another model spin winder, designed to make linear, cylindrical coils, has a 12-station vertical axis turret. The machine automatically loads, winds, taps, cuts leads and tins them, waxes, tapes and unloads finished coils.

*The Henry Mann Co.* does not manufacture coil winders but markets them



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## TOROID WINDERS

### MODEL 900A

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CIRCLE 18



with a Mann label. One of the two models is equivalent to the Excelsior Electronics unit, the other to the Innes Instrument machine.



Fig 3 Typical single spindle machine set up to wind bobbins.

Solatron Enterprises manufactures a multiple head bobbin winder which features an automatically self-adjusting traverse: bobbin length determines traverse length. The machine accommodates any bobbin from 1/2" to 4" long; each spindle operates independently. The operator may wind different coils on each spindle; the winding pitch must be identical on each spindle.

Two Solatron lathes wind linear potentiometer coils only; the third model winds linear as well as other functions to a claimed accuracy of 0.01%. This latter model incorporates a self-correcting feature which monitors the resistance of the winding during production and makes pitch corrections to effect a coil that corresponds to the very precise master function, linear or not, generated by the machine. By means of a varnishing and baking attachment, one of the two linear winders produces coils ready for installation. Winding wire 0.0007" on centers at about 6000 rpm, the machine produces 360" of finished coil per hour. An optional attachment automatically cuts the continuously wound coils to the correct length.

To round out the equipment line, Solatron markets a single-turn potentiometer coil-former and coil-buffing machine.

Slocum Industries' bench top winder

uses 16 to 48 AWG wire up to 4" OD x 6" long to make prototype and small lot quantity coils at spindle rotating speeds of 50 to 5000 rpm.

Geo. Stevens Mfg. Co. manufactures a line of winding machines (Fig 3) to produce all types of coils, except toroidal coils, including winders that produce armature and yoke coils.

One of the latest machines of the line, a heavy-duty hand winder, coils wires as heavy as 2 AWG, for distribution transformers, to maximum 24" OD. It comes in three models — two with a 2 HP and one with a 5 HP SCR-controlled motor. Each model has a 4-speed gear selector, and each gear provides a different speed range from zero to the maximum the motor delivers.

Universal Manufacturing Co. presents an unusual combination winder attachment by which an operator can quickly change a toroid machine to a bobbin machine (Fig 4). After change-over, using the 6BA attachment, an operator can produce coils from 0.05" to 3.5" wide up to 6" OD of 22 to 50 AWG wire. Infinitely variable winding speeds to 6000 tpm and infinitely



Fig 4 Combination toroidal and bobbin winder shows the equipment set to wind bobbins. Operator can change the head quickly with assemblies of various sizes to produce toroids.

variable pitch, combined with solid state turns counting and dynamic braking, assure minimal turn overrun.

#### toroidal-type winders

In most toroidal-type winders, the ring core to be wound mounts horizontally within the machine on a set of driving rollers or table. A thin, large diameter, channel-shaped split ring or shuttle freely runs vertically through the center of the core on a set of driving rollers (Fig 5). As the shuttle turns, the operator winds a specific length of wire onto it — just enough to coil the necessary turns on the toroid. After loading the shuttle, the operator

attaches the leading end of the wire to the core and winds the coil by turning the shuttle in the opposite direction.

For many years, coil winding equipment manufacturers have tried to develop a toroidal winder that eliminates the shuttle. Such a machine could substantially lower the cost of winding toroids because the operator could wind the coil directly from the reel of wire. Rumors have persisted that the problem has been solved; yet no manufacturer markets a winder that can cover an unbroken ring core with coils without a shuttle-like tool.

Arnold Magnetics Corp. produces a winder (Fig 5) that handles 26 to 44 AWG wire. The machine's shuttles pass through 0.18" ID finish-wound cores of 4" OD maximum and 1.5" thickness. Turns accuracy claim is 1/2% or one turn, whichever is greater.

Coil Winding Equipment Co. manufactures a base unit either as four individual machines or as one machine with four stepped sizes of winding heads, two sizes of 360° roller tables and 180° segmental winding clamps. The operator can quickly interchange all these parts. The base unit has an infinitely variable control for the heads as well as for the traverse of the 360° tables and 180° clamps. Smallest core ID is 0.32" x 3"; smallest OD wound by the smallest head, to 1.187" ID x 10" OD minimum.

Coweco markets three large winders, the largest of which handles a minimum core ID of 9-1/4" x 24" OD maximum x 7.9" maximum height.

Gorman's toroid winders allow you to use 4" or 6" dia shuttles. With 4" shuttles, minimum core ID is 0.055" x 2" OD; with 6" shuttles, 4" OD maximum x 2" height maximum. Gorman machines have a jockey stick core positioning feature which allows the operator to move the entire core holder assembly horizontally in any direction during the winding.



Fig 5 A small toroidal coil winder.



The machines come in three models, one of which is a prototype model. Model 900A resembles Model 700, except for the following additions: two predetermining counters for loading and winding and an overhead, machine-mounted de-reeler with footage counter.

*Donald C. Harder Co.* makes seven models; the smallest uses a 5" shuttle, the largest a 24". Instead of using a slide on the shuttle, the machines employ a circumferential coil spring to retain the wire within the shuttle. Centrally located within the shuttle groove, a flat, polished plate over which the wire passes guides the wire onto the toroid. The coil spring sets the tension; interchangeable springs set the range of tensions. Smaller machines wind 1/8" ID minimum cores while the largest wind 3/4" ID minimum. Maximum coil OD's are 2" and 8" respectively.

*Leesona* markets two models, of which Model TO-134 has fewer options and attachments. This machine uses only one size shuttle, 6", to wind cores as small as 0.055" ID x 2-1/2" OD maximum x 2" high maximum. Sliders are factory adjusted for constant tension. Core rotation is automatic to 360° continuous or any part thereof. The machine can wind segments from 0 to 200° in multiple layers.

Model TO-125 CE accommodates six different shuttle systems plus core holding attachments. This model can wind at zero to 2000 tpm with a 4" shuttle but works proportionally slower for larger shuttles. The machine has electronic turns and linear counters, controlled deceleration, controlled, automatically variable wire spacing and many other desirable operating characteristics. The smallest ID that can be wound on the TO-125 CE machine is 0.028". This operation takes a hollow tube shuttle with the wire coiled in the tube on a special shuttle loader. The remaining five shuttle head assemblies cover the range of coils from 1/16" ID to 3/4" OD, to 1/2" ID to 5" OD.

*PLR Labs* produces a toroidal winder capable of speeds of 0 to 2500 tpm. It handles 16 to 48 AWG wire and winds cores with a finished ID as small as 1/16" and an OD as large as 6". A solid state motor drive and an electronic counter provide the controls.

*Universal Manufacturing's* Models 2-S and LS-2 each feature a quick-acting



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**Eubanks**



"twist-lock" mounting for head changeover. Model 2-S has five interchangeable toroidal coil winding heads, ten random and geared layer coil winding heads and a taping head for 1/4" and 3/8" wide non-adhesive tapes. Model LS-2 has nine layer and random winding heads plus one 1/4" and 3/8" wide capacity taping head. Both machines wind cores with 0.055" minimum ID's and 5-1/2" max OD's. And, as previously noted, the manufacturer provides a bobbin coil winding attachment for both machines.

Basic Model UST, larger than the two models above, winds larger coils and handles heavier wire. Universal makes four interchangeable coil winding heads and one taping head for this model which can produce cores from 0.45" ID to 28" OD from wire as heavy as 5 and as fine as 40. The tape head accommodates 1/2", 3/4" and 1" wide non-adhesive widths.

For more information on these products, Circle 210.

### BUYER'S GUIDE

Use this list for manufacturers' names and phone numbers (Table I, page 31).

#### Coil Winding Machines, Lathe Type

**ALCH INSTRUMENT CO., INC.**, 32 Urban Ave., Westbury, N.Y. 11590 (516)334-7970

**ASSOCIATED AMERICAN WINDING MACHINERY INC. (AMACOIL)**, 111 Plain Ave., New Rochelle, N.Y. 10801 (914)235-5050

**CM MANUFACTURING CO.**, 103 Dewey St., Bloomfield, N.J. 07003 (201)338-6500

**COIL WINDING EQUIPMENT CO. (COWECO)**, Railroad Plaza, Oyster Bay, N.Y. 11771 (516)922-5660

**ELDEN MANUFACTURING CO.**, 2712 N. Elston St., Chicago, Ill. (312)276-2192

**EUBANKS ENGINEERING CO.**, 225 W. Duarte Rd., Monrovia, Calif. 91016 (213)358-4531

**EXCELSIOR ELECTRONICS CO.**, 7448 Deering St., Canoga Park, Calif. 91303 (213)884-1605

**FREY TOOL & MFG. CO.** 7912 W. Grand St., Chicago, Ill. (312)453-3100

**GORMAN MACHINE CORP.**, 480 S. Main St., Randolph, Mass. 02368 (617)963-7333

**HALM INSTRUMENT CO., INC.**, Glen Head Rd., Glen Head, N.Y. 11545 (516)676-6700

**INDUSTRIAL WINDING MACHINERY CORP.**, Box 45, River Edge, N.J. 07661 (201)488-4492

**INNES INSTRUMENT**, Box 5216, Pasadena, Calif. 91107 (213)796-3288

**KAHLE ENGINEERING CO.**, 3322 Hudson Ave., Union City, N.J. 07087 (201)867-6500

**LEESONA CORP., COIL WINDING MACHINERY DIV.**, Box 5000, Danbury, Conn. 06810 (203)744-5510

**HENRY MANN CO.**, Box 237, Cornwell Heights, Pa. 19020 (215)639-6200

**MARTINDALE ELECTRIC CO.**, Box 617, Cleveland, Ohio 44107 (216)521-8567

**MS & R INC.**, Colonial Manor Rd., Irwin, Pa. 15642 (412)863-1000



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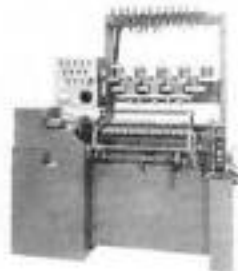
CIRCLE 22



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## PAPER INTERLEAF COIL WINDERS



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**Model 108**

Speeds production of a wide variety of paper insulated coils with extreme accuracy. Easy to operate. Four fingertip controls govern gearing for wire size, winding length, turns per layer, without removing cams or gears.

## HIGH SPEED BOBBIN WINDERS



**Model 115 Bachi Single Head**

Spool-winds coils up to 3" diameter x 2 3/4" long for small devices such as electric shavers and field coils in small motors. Completely automatic. Fast, accurate, reduces handling. Winds up to 1000 coils per hour.

## TOROIDAL WINDERS



**Model TO-125CE**

The ultimate in toroidal winders for high production and product uniformity. Permits fast and flexible changes in setup and produces wide range of coils from .028" ID to 5" OD, wire sizes #16 through #50 AWG. Variable speeds, quick change interchangeable shuttle heads and attachments. Solid state circuitry.



**Model TO-134**

Designed for versatility and reliability with economy. Produces wide variety of finished coils ranging from .055" ID to 2 1/2" OD.

## KINOMAT WINDERS



**Model BGO-2**

Automatically loads, winds, cuts and tins leads, waxes, solders terminals, tapes, provides continuity check and automatically unloads coils.

The twelve position turret can be equipped to wind and produce single and multilayer linear coils, normal and progressive cross-wound coils, non-linear windings and precision layer wound self-supporting or bobbin wound coils. Wire sizes 18 to 50 AWG can be wound single or bifilar up to 5 winding heads per machine.



**Model BV4-G**

Carousel type winder designed to wind air wound coils. Coils produced may be close wound, ranging out to open helix configurations at production rates of up to 1900 per hour. This fully automatic machine features lead tinning and forming to 5 standard lead configurations.



**Model BGV-2**

Single purpose unit designed for a specific job. Winds uniform coils in single or multiple layers. Coils can be close wound or with adjacent turns spaced out accurately. Handles forms with or without leads. Production rates up to 900 coils per hour.



**Model SRV**

Fully automatic lead welding of components with end caps is achieved at 4,000 pieces per hour. Lead wires are fed from spools, straightened, cut to length and welded. A cap assembly machine, Model IRS, is also available.

The complete line of La Cesa Coil Winding Machinery for the larger wire sizes is distributed and serviced exclusively by Leesona. Models range from simple hand operated machines to large multiple wire and aluminum foil winders. La Cesa-Sidney Heavy Duty Winders are also available.



# LEESONA CORPORATION

COIL WINDING MACHINERY DIVISION

MIRY BROOK ROAD, DANBURY, CONN. 06810 TELEPHONE (203) 744-5510 TELEX: 96922

CIRCLE 23

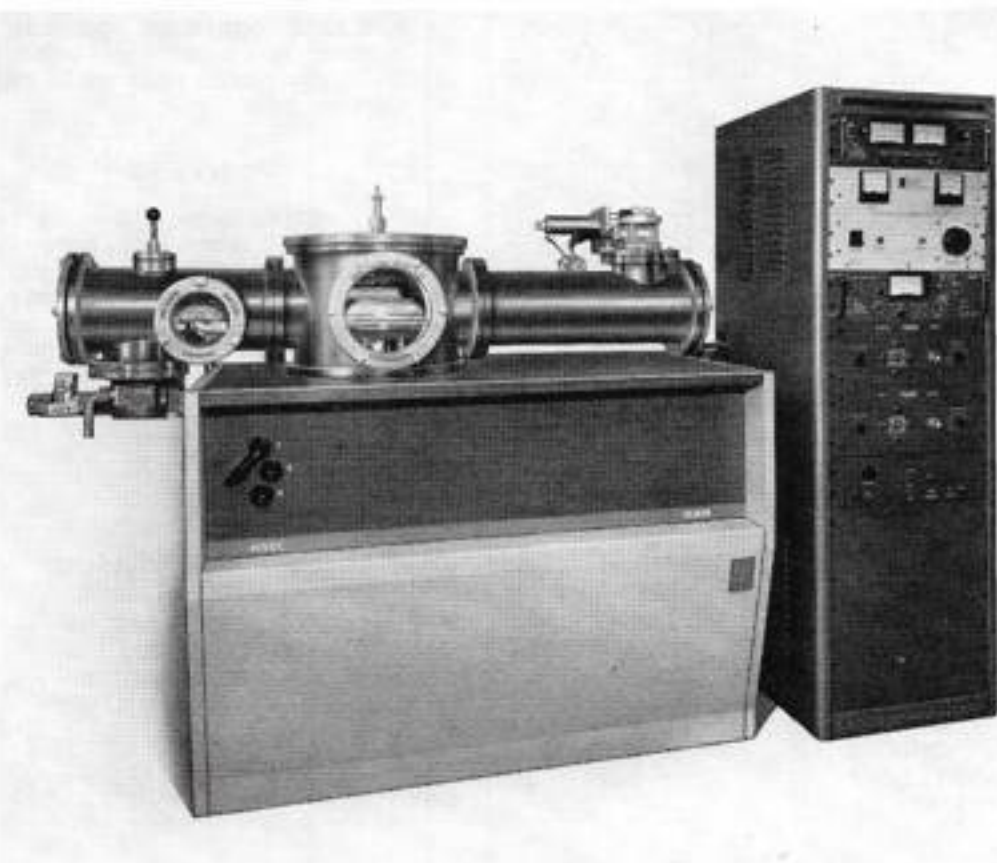
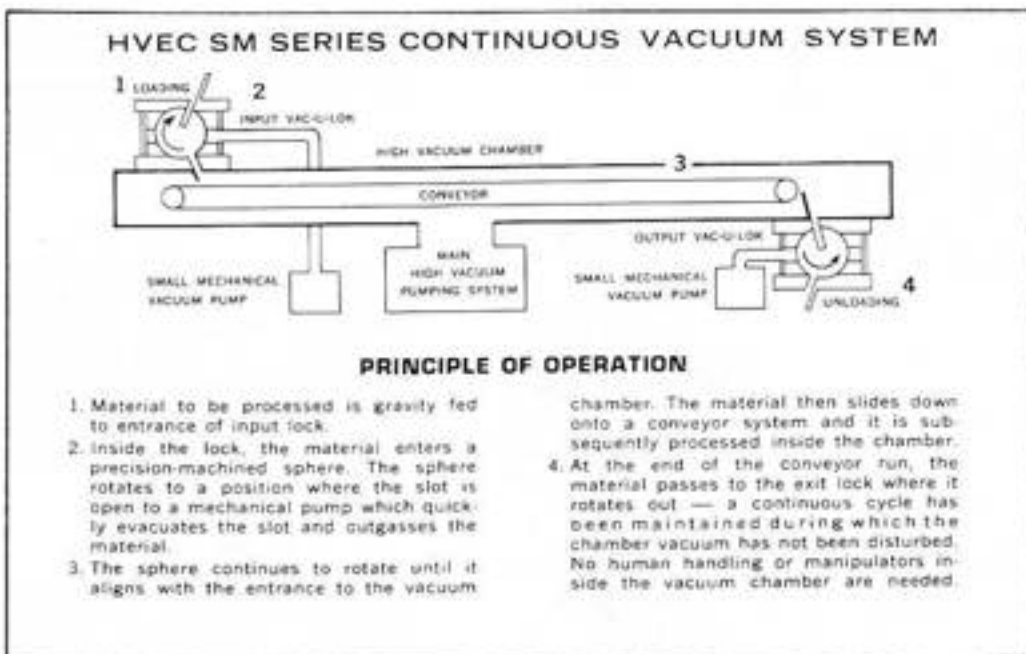


# NEW AUTOMATED SPUTTERING SYSTEM

For small scale automated production of thick and thin films

- No need to open chamber to load or unload
- Consistent, high quality — high yields
- Variety of operations performed — DC or RF sputtering, cleaning, bake-out, single or multiple deposition
- Mounts directly on any 19" or 20" evaporator baseplate

The New SM 23 System accommodates substrates up to 2" x 3" x 3/16". Chamber pressure, gas composition, temperature distribution, sputtering time and rate can be maintained constant, or varied to meet production requirements.



For further information on the SM Series Systems or HVEC patented Vac-U-Loks for automating your own system, write:



**HIGH  
VACUUM  
EQUIPMENT  
CORPORATION**

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**CIRCLE 24**

assembly & production machinery

## BUYER'S GUIDE (con't)

**REA MAGNET WIRE CO., INC.**,  
3610 E. Pontiac St., Fort Wayne, Ind.  
46806 (219)743-8032

**SLOCUM INDUSTRIES INC.**, Box  
687, Reseda, Calif. 91335  
(213)783-8803

**SOLATRON ENTERPRISES**, 421 E.  
Beach Ave., Inglewood, Calif. 90302  
(213)678-4981

**GEO. STEVENS MFG. CO., INC.**,  
6001 N. Keystone Ave., Chicago, Ill.  
60646 (312)588-1300

**UNIVERSAL MFG. CO., INC.**, 1168  
Grove St., Irvington, N.J. 07111  
(201)374-9800

**WASHINGTON ELECTRICAL PROD-  
UCTS CO.**, 1400 S. Stafford St.,  
Washington, Mo. 63090  
(314)239-2731

## Coil Winding Machines, Toroid Type

**ARNOLD MAGNETICS CORP.**,  
11264 Playa Ct., Culver City, Calif.  
90230 (213)390-3537

**COIL WINDING EQUIPMENT CO.  
(COWECO)**, Railroad Plaza, Oyster  
Bay, N.Y. 11771 (516)922-5660

**DINION COIL CO., INC.**, 5 Dinion  
Circle, Caledonia, N.Y. 14423  
(716)538-4412

**GORMAN MACHINE CORP.**, 480 S.  
Main St., Randolph, Mass. 02368  
(617)963-7333

**DONALD C. HARDER CO., INC.**,  
2580 K St., San Diego, Calif. 92102  
(714)239-8021

**INDUSTRIAL WINDING MA-  
CHINERY CORP.**, Box 45, River  
Edge, N.J. 07661 (201)488-4492

**LEESONA CORP., COIL WINDING  
MACHINERY DIV.**, Box 5000, Dan-  
bury, Conn. 06810 (203)744-5510

**MARTINGDALE ELECTRIC CO.**,  
Box 617, Cleveland, Ohio 44107  
(216)521-8567

**PRL LABS**, 10 Highview Rd., New  
Milford, Conn. 06776 (203)354-2864

**UNIVERSAL MFG. CO., INC.**, 1168  
Grove Street, Irvington, N.J. 07111  
(201)374-9800



AW




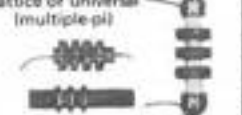
TABLE 1 COIL WINDING EQUIPMENT MANUFACTURERS BY COIL TYPE

TYPE OF COIL TO BE WOUND	1 Single-layer, close wound (see also Type 4)			2 Single-layer, space wound (see also Type 4)			3 Air wound (self-supporting)			4 Single-layer strips (see also Types 1 & 2)		
	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY
TYPICAL APPLICATION	Resistors R.F. Coils Peaking Coils Flashers Voltage Dividers			Resistors R.F. Coils Peaking Coils Flashers Voltage Dividers			R.F. Inductances			Potentiometers Delay Lines		
EQUIPMENT MANUFACTURER	MACHINERY FOR			MACHINERY FOR			MACHINERY FOR			MACHINERY FOR		
ALCH *												
AMACDIL	•	•	•	•	•	•	•	•	•	•	•	•
ARNOLD												
CM *												
COWECO	•	•	•	•	•	•	•	•	•	•	•	•
DINION *												
ELDEN	•	•	•	•	•	•	•	•	•			
EUBANKS	•	•	•	•	•	•	•	•	•	•	•	•
EXCELSIOR												
FREY *												
GORMAN	•	•	•	•	•	•	•	•	•			
HALM								•	•			
HARDER												
INDUSTRIAL *												
INNES												
KAHLE								•	•			
LEESONA												
MANN								•	•			
MARTINDALE *												
MS *												
PARK												
REA *												
SOLATRON											•	•
SLOCUM	•	•										
STEVENS	•	•	•	•	•	•	•	•	•	•	•	•
UNIVERSAL												
WASHINGTON *												

\* Although these manufacturers did not respond to our questionnaire, we believe that they produce coil winding equipment. You should fill in the blanks from any literature you may receive from them. Use the Buyer's Guide on pages 28 and 30 for their addresses and phone numbers.

2



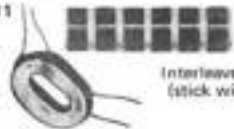



TYPE OF COIL TO BE WOUND	5  Bobbins, solid core hollow core			6  Interwoven (acetate, cotton, glass, etc.)			7  Lattice or universal (single-pi)			8  Lattice or universal (multiple-pi)		
	TYPICAL APPLICATION			Solenoids, Relays			Flybacks Antenna & I.F. Coils R.F. Power Supplies R.F. Chokes Lumped Delay Lines			Flybacks Antenna & I.F. Coils R.F. Power Supplies R.F. Chokes Lumped Delay Lines		
EQUIPMENT MANUFACTURER	MACHINERY FOR			MACHINERY FOR			MACHINERY FOR			MACHINERY FOR		
	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY
ALCH *												
AMACOIL	•	•	•	•	•	•	•	•	•	•	•	•
ARNOLD												
CM *												
COWECO	•	•	•	•	•	•	•	•	•	•	•	•
DINION *												
ELDEN	•	•	•				•	•		•	•	
EUBANKS	•	•	•	•	•	•	•	•	•	•	•	•
EXCELSIOR	•	•										
FREY *												
GORMAN	•	•	•	•	•	•						
HALM												
HARDER												
INDUSTRIAL *												
INNES	•											
KAHLE		•	•		•	•						
LEESONA		•	•		•	•		•	•		•	•
MANN	•	•										
MARTINDALE *												
MS *												
PARK												
REA *												
SOLATRON		•	•									
SLOCUM	•	•										
STEVENS	•	•	•	•	•	•	•	•	•	•	•	•
UNIVERSAL	•	•		•	•		•	•				
WASHINGTON *												

Although these manufacturers did not respond to our questionnaire, we believe that they produce coil winding equipment. You should fill in the blanks from any literature you may receive from them. Use the Buyer's Guide on pages 28 and 30 for their addresses and phone numbers.



TABLE I (cont.)

TYPE OF COIL TO BE WOUND	9 Progressive universal  standard compensated			10 Bank winding distributed bobbin Compensated distributed bobbin 			11  Interleaved coils (stick winding)			12  Toroids		
	TYPICAL APPLICATION			R.F. And Other Inductances With Low Distributed Capacity Distributed Delay Lines			Transformers Reactors Audio Chokes			Rheostats Autotransformers		
EQUIPMENT MANUFACTURER	MACHINERY FOR			MACHINERY FOR			MACHINERY FOR			MACHINERY FOR		
	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY	PROTO-TYPES	MEDIUM QUANTITY	LARGE QUANTITY
ALCH *												
AMACOIL	•	•	•	•	•	•	•	•	•			
ARNOLD										•	•	•
CM *												
COWECO	•	•	•	•	•	•	•	•	•	•	•	•
DINION *												
ELDEN												
EUBANKS	•	•	•	•	•	•	•	•	•			
EXCELSIOR												
FREY *												
GORMAN							•	•	•	•	•	•
HALM												
HARDER										•	•	•
INDUSTRIAL *												
INNES												
KAHLE												
LEESONA								•	•	•	•	•
MANN												
MARTINDALE *												
MS *												
PARK										•	•	•
REA *												
SOLATRON												
SLOCUM												
STEVENS	•	•	•	•	•	•	•	•	•			
UNIVERSAL										•	•	•
WASHINGTON *												

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