Radio and Model Engineering

10 cents a Copy - 570 West 184th Street, New York City - $1.00 Per Year

Vol. I JUNE, 1921 No. 2

Editorial

AS an Experimenter whose chief interest is in the things which are going to come, it is only natural for you to wonder what the publishers of RADIO AND MODEL ENGINEERING have planned for the future issues. It is a fair question to ask, and, in fairness to you, it should be answered.

RADIO AND MODEL ENGINEERING, as it increases in size and circulation, will not become a *popular* magazine or a *technical* magazine. It will be a trade magazine for Experimenters who build their own apparatus and do experimental work in their own homes. The publishers believe that the substantial part of experimental work is not done by *cranks*, but by serious-minded men, and for them the articles in R and M will be written.

If you are seriously interested in experimenting, you want facts based on knowledge and experience. Therefore, it has been decided that nothing will be described in R and M until it has been made and tested, and the description or discussion will be confined to actual results. As a man who works under the handicap of limited facilities, you want articles on apparatus you are able to make of parts you can get; not what you would like to make of parts you can't get. Special care will be taken in designing apparatus for R and M, so that it can be made in the "Kitchen table workshop" of parts so standardized as to make them equally well adapted for a wide range of entirely different instruments. You will find that this plan makes your work easier as well as less expensive.

Moreover, R and M is of the handy standard size used for engineering books and proceedings. It is punched for a standard three-ring binder. The paper is heavy to withstand wear, smooth to give fine illustrations, and costs four times as much as ordinary stock. It starts on the first inside page to give you information and data for your work, and keeps on the job to the last cover. The publishers believe that such a magazine will sell on its own merits, without the support of advertising.

My own ambition is to see R and M with a hundred pages of articles each month. One page will be added with each thousand increase in circulation. If you like the RADIO AND MODEL ENGINEERING idea, do your part toward increasing the number of articles.

Send in your dollar for a year's subscription.

M. B. SLEEPER, *Editor.*

A Loose Coupler That Does What Is Expected Of It.

Homemade loose couplers seldom meet the expectations of the experimenter in the matter of wavelength range. Here are some ideas which cannot go away.

Loose Couplers and Wavelength.

MOST Experimenters are over the idea that the bigger the antenna the louder the signals. For all-round work a single wire 100 ft. long, averaging 30 ft. high, is the thing. Such an antenna is best suited for wavelengths from 200 to 2,500 meters.

The wavelength of any circuit depends on the amount of capacity and inductance in that circuit. Since the antenna provides the capacity of the primary circuit, the inductance of the primary must be of such a size as to give, with the antenna capacity, the wavelength range required.

The usual loose coupler, bought or homemade, has enough taps on the secondary, to look reasonable. But, usually, there is very little reason connected with it. Unless a condenser is used in the secondary circuit, sharp tuning cannot be obtained, and if a condenser is used, the taps should be so arranged, that, with a specified condenser, the wavelength with maximum capacity at one tap will be slightly higher than the wavelength at minimum capacity on the next tap. This provides an overlap.

The Panel Type Loose Coupler.

A PARTICULAR disadvantage of the ordinary loose coupler is that the controls are not of the rotary type, mounted on the panel. In the instrument illustrated in Fig. 1, however, the primary and secondary coils are mounted at right angles to give zero coupling. Coupling is provided by the primary coupling coil which rotates inside the secondary.

Two switches at the left control the primary inductance, one for small steps and one for large steps, and a single switch, on the right regulates the secondary coil. No primary condenser is needed, but a G. A. STD variable condenser, 0.0008 mfd., is required for fine tuning in the secondary circuit. Connections for this instrument are the same as for an ordinary loose coupler. Specifications are given for two sets of coils, one for 200 to 1,000 meters, and one set for 200 to 2,500 meters, according to the requirements of the builder.

Laying Out the Panel.

FIG. 2 shows the front panel, rear connection panel, primary coil at the left, and secondary coil at the right, variometer shaft contact spring, and coil mounting post, with a diagram of connections in the lower corner. It is hard to make the average Experimenter understand that his combination square, dividers, scriber and center punch are his best friends on a job of this sort. Since the drawings have been laid out exactly to scale and reduced one-half, to determine a dimension, it is only necessary to set the dividers on the drawing and lay off that distance twice on the panel. In this way fine work can be done easily.

The Inductances

FIG. 3 shows the long and short wave coils. The same size tubes, of the dimensions given in Fig. 2 are used for all the coils. For the secondary, either long or short wave, a considerable portion of the tube is not wound. This is done so that the screws which hold the coil mounting pillars to the panel will be out of sight under the coupling dial.

SHORT WAVE PRIMARY: The short wave primary coil is wound with No. 24 S. S. C. wire on a G-A-Lite tube 3¼ ins. long and 3½ ins. in diameter. Starting 5/16 ins. from the left hand end, taps are taken off at the following turns: 0, 2, 4, 6, 8, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 and 110. The first five are connected to the upper switch, and balance to the lower. An extra switch point is provided at each extremity so that the lever will not slip off. The full coil has an inductance of 1.0 millihenry which, with an antenna of 0.0003 mfd., gives a maximum wavelength of 1,032 meters.

SHORT WAVE SECONDARY: The same tube and wire are used for this coil.

Start the winding ¼-in. above the center of the shaft hole, and take off taps at the 24th turn, and the 62nd, which is the end of the coil. The inductance with the first tap is 0.08 millihenry and 0.40 millihenry with the full coil. This gives a range with a 0.0008 mfd. condenser of 169 to 477 meters and 377 to 1,066 meters.

LONG WAVE PRIMARY: Three banks of No. 24 S. S. C. wire are required for the long wave primary. Like the other, start the winding 5/16-in. from the left hand end, taking off taps from the following turns: 0, 6, 9, 12, 15, 18, 21, 39, 57, 75, 93, 111, 129, 147, 165, 183, 201, 219, 237, 255 and 273. The first six go to the upper switch, and the balance to the lower. The full coil has an inductance of 6.0 millihenries, which, with a 0.0003 mfd. antenna gives a maximum wavelength of 2,529 meters.

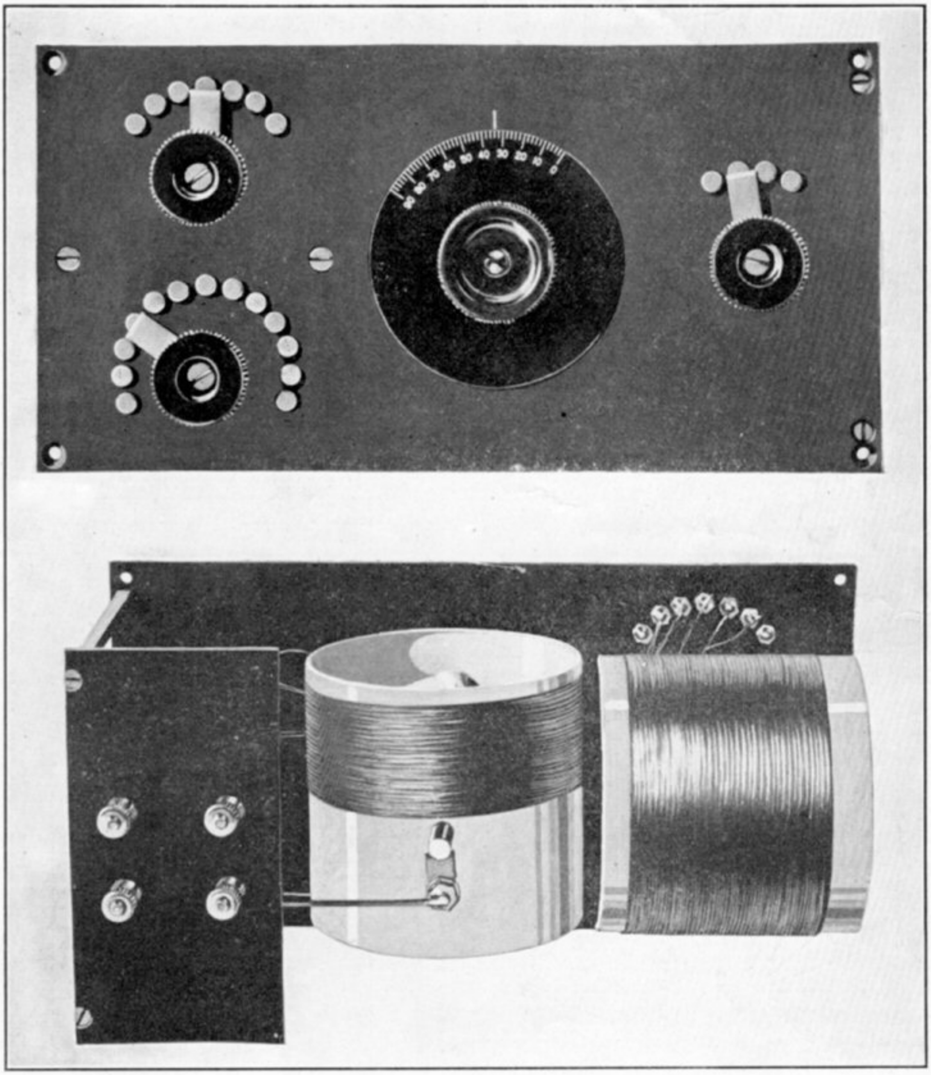

Fig. 1. Front and rear views of the panel control loose coupler with rotating ball coupling adjustment.

LONG WAVE SECONDARY: Here again a 3½-in. tube 3¼-in. long is wound with No. 24 S. S. C. wire in three

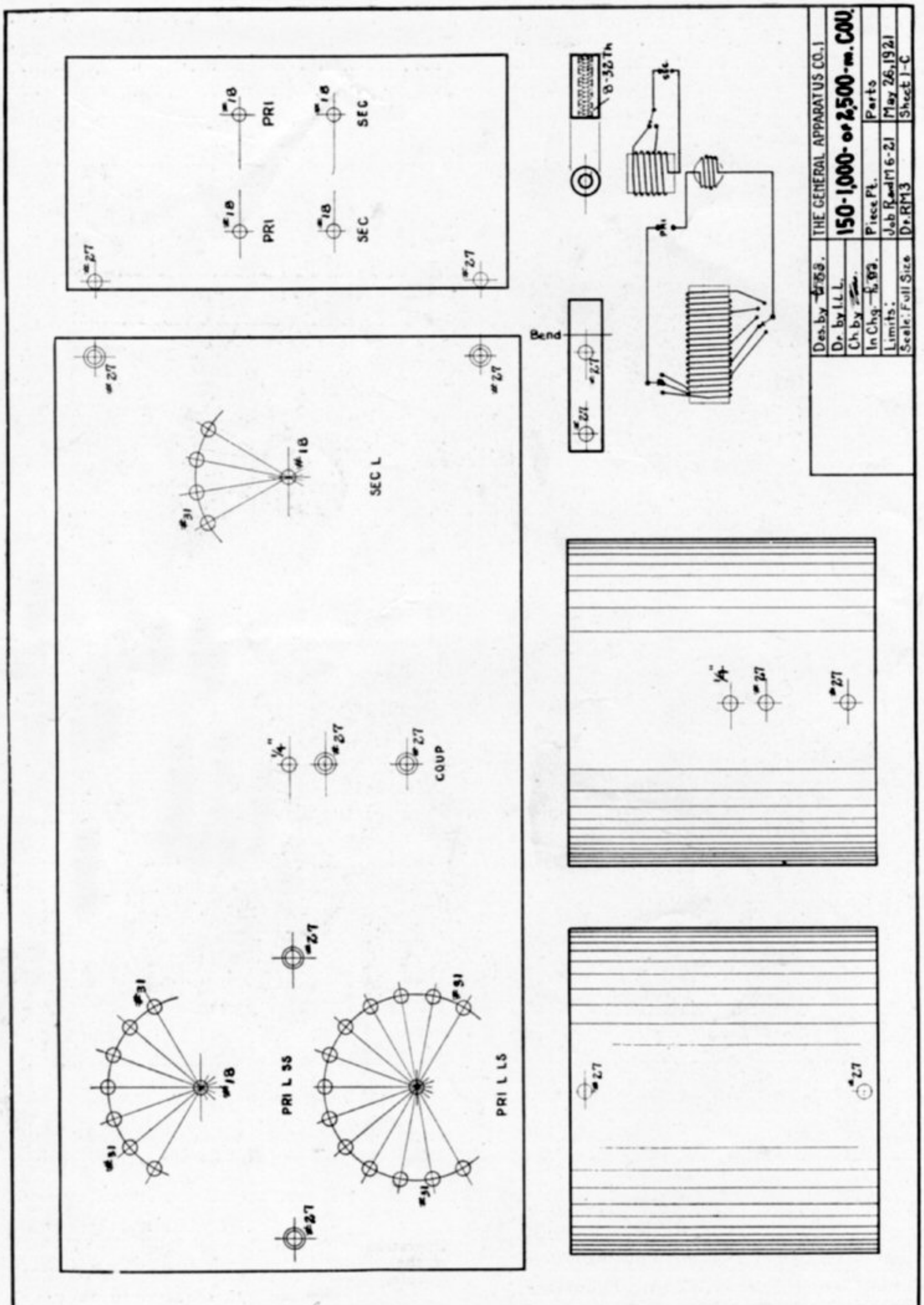

Fig. 2. Details and diagram for the loose coupler. Dimensions can be scaled off for the drawing was reduced one half.

banks. Start the winding ¼-in. above the rotor shaft hole, and take off taps at the 21st, 57th and 145th turn, which is the end of the coil. The inductances at these three points are 0.09, 0.50, 2.50 millihenries, and the wavelength ranges with the regular winding. After the coil has been given a coat of Valspar and the varnish dried, cut the extra turns in the middle and twist the two parts together close to the coil. There is your tap. Do not twist the wire too tightly or it will

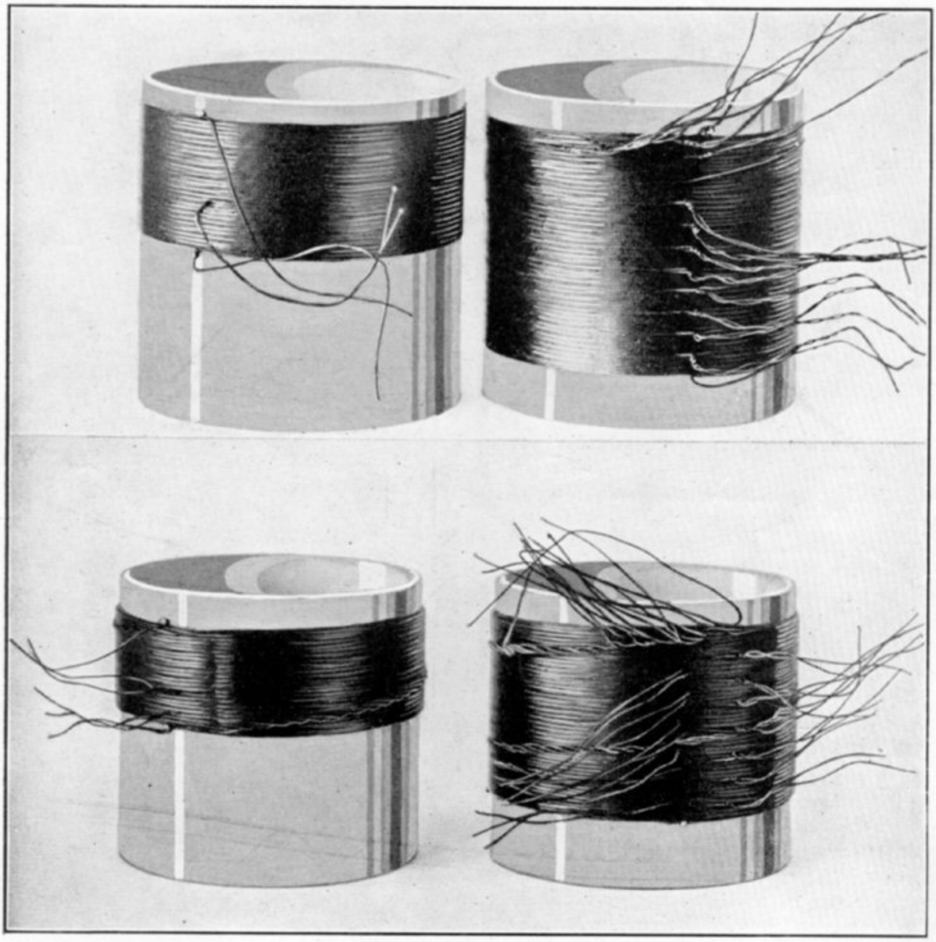

Fig. 3. Above coils for the short waves; below, the long wave primary and secondary.

a 0.0008 mfd. G. A. STD condenser 179 to 506, 421 to 1,192, and 942 to 2,665 meters respectively.

TAPPING THE COILS: There is a very easy way to take off taps on coils of this sort. When a tapping point is reached, instead of twisting or cutting the wire, merely bend the wire to one side and put one turn around the part already wound. End this extra turn just where it was begun, and carry on with break. A tap not yet twisted is shown in Fig. 3, near the top of the upper right hand coil.

Operation of the Coupler.

THIS loose coupler, fitted with the long or short wave coils will receive spark, modulated undamped waves, voice or music when connected with a crystal or audion detector. A G. A. STD variable condenser, 0.0008 mfd., is needed for the secondary.

Commercial Practice Applied to Experimental Radio Stations

By M. B. Sleeper.

Antenna and Ground Systems—There are many things about this subject which even the experienced Experimenters do not know; things often done incorrectly but as easily done right.

Introduction.

THE data to be given concerning the application of commercial practice to the construction of experimental radio stations has been planned for the man who is primarily interested in making apparatus which gives the results, rather than for those who want to know how and why those results are obtained. Experimenters are handicapped in their selections of methods by conflicting reports from different sources.

Thus Commercial Practice Applied to Experimental Radio Stations will clear up contradictions which come from Experimenters such as one who recently assured the writer that his audion worked as well whether the negative or positive B battery lead was connected to the plate. He was perfectly sincere; he just didn't know.

Antenna Capacity.

FEW Experimenters think of the antenna in terms of capacity in microfarads. "Antenna" usually means little more than elevated wires. Actually the antenna, except in the case of a loop, is a capacity which controls, with the inductance, the wavelength of the antenna circuit. The antenna capacity and tuning inductance must be selected with reference to the required wavelengths just as condensers and coils are chosen for other parts of the receiving or transmitting circuit. It is well to have the antenna high and long, but it is a poor antenna indeed if it cannot be tuned down to the wavelengths required.

Actually, the antenna is to the primary inductance what the secondary condenser is to the secondary inductance. Of course, these two circuits must be designed to tune to the same wavelengths. If a variable condenser is shunted around the primary coil, the wavelength is increased because the condenser capacity is added to that of the antenna. In series, however, the variable condenser reduced the wavelength for the effective capacity becomes the reciprocal of the sum of the reciprocals of the antenna and condenser capacities.

Thus, when an antenna of 0.0003 mfd. is connected to a primary coil around which a variable condenser of 0.0002 to 0.001 mfd. is wired, the effective capacity ranges from 0.0005 to 0.0013 mfd. If the coil is of 1,000,000 cms. inductance, the wavelength range[1] is 1,333 to 2,065 meters. On the other hand, this condenser in series makes the effective capacity 0.00012 to 0.00023 mfd., and the wavelength range 653 to 900 meters.

Antenna capacity can be determined in the following way:

Connect the antenna and ground to a small inductance shunted by a calibrated condenser and audion detector. This forms a simple, directly coupled receiving circuit. Couple to the coil a buzzer excited wavemeter or a small coil shunted by a variable condenser, with a buzzer and battery connected around the coil. Adjust the circuits until, with only a small capacity in the antenna circuit condenser, the buzzer signals are audible in the telephones. Then disconnect the antenna and ground, and increase the capacity of the antenna condenser until the buzzer signals come in again. The amount by which the condenser capacity is increased is the effective capacity of the antenna.

Unless this factor is considered, no tuning circuit can be designed accurately for reception or transmission over a given range of wavelengths[2].

(1) See tables in "Design Data for Radio Transmitters and Receivers" by M. B. Sleeper. This book can be obtained from the General Apparatus Company, Inc., at a price of $.75.

(2) See Inductance Tables, by M. B. Sleeper. Published by The General Apparatus Company, Inc. Price $.25.

Standard Receiving Antennas. EXPERIMENTS on receiving antennas, both large and small, indicate that the long, low, single-wire is the first choice. A large antenna of several wires is of no value for 200-meter work, because the capacity is so high, that, with only the inductances of the antenna itself, the wavelength is more than the 200 meters. From this, it is evident that the largest antenna is not always the best.

Three standard types of single-wire antennas should be kept in mind in planning the exact method of erecting your own: For reception on wavelengths up to 1,000 meters, a single No. 14 B. and S. gauge bare copper wire, 100 ft. long and 24 to 40 ft. high at each end; wavelengths from 1,000 to 3,000 meters, a wire as described, but 200 ft. long; and for reception on waves over 3,000 meters a wire as described 300 ft. long. The lead-in to the apparatus can be taken from any point along the wire without appreciably affecting the results.

The specific application of these types to your particular surroundings can be in a variety of forms. In the suburbs and country, natural supports are usually available. One end can be secured to the house; the other, run to a tree or pole 15 ft. high or more. If the nearest support is too far away, break the wire with an insulator at the proper distance. In the city there are various small houses and tanks on the roofs that can be used as supports, and the lead-in brought down an airshaft or court. The wire need not be more than 10 ft. above the roof. Two or three antennas, running in different directions, can be used for different wavelength ranges.

Grounds for Receiving. A GOOD ground is just as important as the antenna. Several different grounds sometimes work better than one. Where a water pipe is near the set, it should be used. Make sure the connection is perfect, and not subject to moisture which would make it corrode. Some experimenters connect to the heating pipes or hot air system at two or three different points. At the G. A. Company we use the metal ceiling as a ground.

Antenna and Lead-in Insulation. THE greatest care must be taken to provide perfect insulation for the antenna, and low resistance connections. RF insulators are always preferable for they withstand radio frequency currents where others leak and cause losses in the signal strength. For wires up to 200 ft., use the 3-in. type, and the 6-in. size for longer, heavier antennas. These insulators are designed for great strength, and do not become conductive from exposure to weather or during rainstorms.

(To be Continued)

Standardized antenna materials.

No. 14 bare copper antenna wire, per 100 ft. (2 lbs.)	$.94
3-in. HF antenna insulator, 350-lb. strain, 33,000 volts (¼ lb.)	.25
4-in. HF air gap antenna insulator, 1100-lb. strain, 37,000 volts (½ lb.)	.65
8-in. HF air gap weatherproof antenna insulator, 1,600 lb. strain, 72,000 volts (1 lb.)	1.60
5-in. HF lead-in insulator, for receiving sets and low-power C.W. or ¼ K.W. spark sets (½ lb.)	.85
9-in. HF lead-in insulator, for high-power C.W. or 1 K.W. spark sets (3 lbs.)	3.10

PARTS FOR THE 150 to 1,000 and 150 to 2,500 METER LOOSE COUPLERS

1—L.P.F. panel 5x10x$\frac{3}{16}$ in. for front (½ lb.)	$1.31
1—L.P.F. panel 2½x5x⅛ in. for rear (3 oz.)	.23
3—Switch, 1-in. radius, $.40 each (2 oz.)	1.20
4—Brass pillars to mount coils, $.08 each (2 oz.)	.32
1—Amrad 90° dial and knob (2 oz.)	.80
2—Rear panel support rods, $.20 each (3 oz.)	.40
Switch points, $.04 each, per dozen (1 oz.)	.40
1—¼-in. brass rod, per 12-in. length (4 oz.)	.15
1—3-in. mahogany variometer ball. (3 oz.)	.90
4—GA-STD nickel plated binding posts, $.10 each (2 oz.)	.40
2—Square copper connection wire, $.06 per 2-ft. length (1 oz.)	.12
1—Piece No. 24 spring sheet brass 5x6 ins. (3 oz.)	.27
1—Short wave primary coil, wound and tapped (8 oz.)	.85
1—Short wave secondary coil, wound and tapped (8 lb.)	1.00
1—Long wave primary coil, wound and tapped (1 lb.)	1.35
1—Long wave secondary coil, wound and tapped (8 oz.)	2.20
1—Package of 6-32½-in. R. H. nickel brass machine screws (1 oz.)	.12
1—Package 6-32 1-in. F. H. nickeled diameter (8 oz.)	.38
Complete set of parts for the 150- to 1,000-meter loose coupler, as listed above, ready to assemble (3 lbs.)	8.80
Complete set of parts for the 150- to 2,500-meter couplet, as listed above, ready to assemble (4 lbs.)	9.75
Auxiliary Parts:	
½-lb. spool No. 24 single silk covered wire 400 feet (½ lb.)	1.25
8-in. length G. A. Lite tubing, 3½ ins. diameter (8 oz.)	.33
GA-STD variable condenser, 0.0008 mfd. (1 lb.)	4.30
L.P.F. panel, 5x5x$\frac{3}{16}$ in. for mounting condenser (6 oz.)	.67
Amrad 180° dial and knob (2 oz.)	.80

The General Apparatus Company; Inc.

570 West 184th Street - - - New York City

BULLETIN No. 2. STANDARDIZED SUPPLIES JUNE, 1921

Standardized Construction of radio apparatus, first introduced by M. B. Sleeper thru the Radio Department of Everyday Engineering Magazine in 1918, has been widely adopted by Experimenters because this system of design assures a source of supply at all times of parts which fit together, or which can be taken from an obsolete instrument and used in a new device. Thus, the discouragement of delays is overcome, and experimental work made less expensive. Moreover, the parts required for apparatus described in Radio and Model Engineering are confined to these standards.

Prices Given here are effective June 1st, 1921. Attention is called to general reductions, in some cases as much as 50% below previous lists. These changes are in keeping with the G. A. policy of encouraging Experimenters to extend the scope of their work. Do not forget the postage.

L. P. F. This new insulating material, for which the G. A. Company is sole distributor, is pre-eminent for radio apparatus because it has the Lowest Power Factor of any sheet material. Consequently the losses at radio frequencies are minimized. For this reason and because it is 25% lower in price than Bakelite, it is rapidly replacing the other materials. Panels have high polish, ground edges, are absolutely square and accurate in dimensions to 1/32 in. Finest material you ever used for drilling, tapping and filing.

Thickness	2½x5 ins.	2½x10 ins.	5x5 ins.	5x10 ins.	7½x10 ins.	10x10 ins.	10x15 ins.
1/8 in.	$.24 (2 oz.)	$.45 (4 oz.)	$.45 (4 oz.)	$.88(8 oz.)		$1.76 (16 oz.)	
3/16 in.			.67 (6 oz.)	1.31(12 oz.)	$2.95 (36 oz.)	2.62 (24 oz.)	$3.93 (2 lbs.)
1/4 in.					3.96 (3 lbs.)	3.52 (32 oz.)	5.28 (4 lbs.)

Class 5-C.

G-A-Lite Tubing is widely used in experimental work because it keeps its shape perfectly without shrinking, has a slightly rough surface suitable for bank winding, and is seamless. 5/32-in. wall, 8-in. lengths, 3-in. outside diam., per length, $.32 (5 oz.) 3½ ins. outside diam., per length $.38 (7 oz.)
Class 2-C.

Condensite Celoron tubing is for receiving and C. W. transmitting inductances. So strong, you can stand on it. Preferred for work of a permanent character, 3/32-in. walls, 5-in. lengths.

3 ins. outside diam..............$1.38 (3 oz.)
3½ ins. outside diam.............. 1.48 (4 oz.)
5 ins. outside diam.............. 1.98 (8 oz.)
4 ins. outside diam...............$1.58 (5 oz.)
4½ ins. outside diam............... 1.98 (6 oz.)

Class 3-C.

Brass Stock Correct hardness for turning, drilling, tapping. Supplied in handy standard lengths. Special sizes furnished in quantity only.

ROUND RODS: 12-in. lengths, ⅛-in. diam..............$ .06 (2 oz.)
3/16-in. diam. .... .09 (4 oz.)
¼-in. diam. .... .15 (7 oz.)
ROUND TUBES: 12-in. lengths, 3/16-in. diam. inside, ¼-in. diam. outside.............. .21 (4 oz.)
SQUARE RODS: 12-in. lengths, 3/16-in. square.............. .11 (6 oz.)
SQUARE TUBES: 2-in. lengths, 1/32-in. wall, to fit square rods.............. .05 (2 oz.)
BRASS SHEET: 5x6 ins. No. 24, spring brass.............. .27 (6 oz.)
No. 30 sheet .... .15 (3 oz.)
BRASS STRIP: 12-in. lengths, ⅜x1/16-in. For brackets and supports.............. .13 (6 oz.)
ANGLE BRASS: 12-in. lengths, ⅜x1/32-in. Handy in apparatus construction.............. .20 (8 oz.)

Class 1-D.

Copper Wire These few sizes cover all ordinary requirements for constructional work. The small variety assures you a ready supply when you need wire quickly.

MAGNET WIRE: Electrolytic copper covered by Italian silk, No. 24 S. S. C. 800 ft. per lb. ¼ lb. 70c., ½ lb. $1.25, 1 lb. $2.25
For variometers and variocouplers, No. 20 D. C. C. 298 ft. per lb. ½ lb.............. .80
HIGH FREQUENCY CABLE: For highest efficiency on wave lengths under 2,500 meters. Made up of No. 38 enameled wires, wrapped with two layers of natural Italian silk.
10—No. 38 strands, per 100 ft..............$ .75 (3 oz.)
20—No. 38 strands per 100 ft.............. 1.25 (6 oz.)
BARE COPPER WIRE: No. 14, medium temper for antennas up to 400 ft. long, per 100 ft.......... $ .94 (1½ lbs.)

Class 2-C.

SQUARE TINNED COPPER WIRE: 1/16-in. square. An innovation for instrument connections. This wire comes in 2-ft. straightened lengths. Can be bent readily for bus bar wiring. Tinning makes soldering easy. Per length ....$ .06 (1 oz.)
Class ½-E.

Machine Screws Sizes listed are standardized by all radio manufacturers. These screws will be found invariably perfect and accurate. Prices are per package of 10. Round heads will be sent unless flat heads are specified. All screws are of brass, hand polished nickel plated.

Gauge	¼-in.	½-in.	1-in.	1½-in.
4/36	$.11	$.11	$.13	....
6/32	.11	.12	.14	.17
8/32	....	.14	.16	.20

NUTS: Brass hex. nuts, polished nickel plated, per package of 10—4-36, 8c; 6-32, 8c; 8-32, 9c.
WASHERS: Copper washers nickel plated, per package of 10—No. 4 hole, 3c.; No. 6 hole, 4c.; No. 8 hole, 5c.

Class 1-D.