

THORDARSON

RADIO APPARATUS

Unconditionally Guaranteed

RECEIVING

THORDARSON ELECTRIC MANUFACTURING CO.
HURON AND KINGSBURY STS.
CHICAGO, ILL.

THORDARSON

RADIO APPARATUS

(Unconditionally guaranteed)

Receiving

THORDARSON ELECTRIC MANUFACTURING CO.

HURON AND KINGSBURY STS.

CHICAGO, ILL.

THORDARSON

ELECTRIC MFG. CO.

TRANSFORMERS FOR EVERY PURPOSE

Gold Medal

Awarded
Louisiana Purchase
Exposition
St. Louis, 1904



These medals denote the international appreciation of the development work done by Mr. C. H. Thordarson, President of the Thordarson Electric Manufacturing Co.



Gold Medal

Awarded
Panama Pacific
Exposition
San Francisco, 1915

THORDARSON

ELECTRIC MFG. CO.

TRANSFORMERS FOR EVERY PURPOSE



A BIT OF HISTORY

THE Thordarson Electric Mfg. Co. is the largest and oldest exclusive manufacturer of small transformers in the country. Organized in 1895 the company has enjoyed a steady growth in scope, prosperity and good will for the past 28 years.

Every conceivable type of transformer is made in the Thordarson factory: X-Ray, bell-ringing, power, welding, sign-lighting, Rhumkorff coils, ignition transformers, testing transformers, etc.

The world's first million-volt transformer was a product of the Thordarson factory, and at the Panama Pacific Exposition in San Francisco in 1915, many thousands of people witnessed the experiments conducted with this marvel of the age. Many universities and colleges throughout the country use Thordarson high voltage transformers up to 500,000 volts in their laboratories.

Radio is far from being a new field to Thordarson. 1904 marks the building of the first Thordarson spark transformer. The old time "ham" operator has a tender spot in his heart for this, now almost extinct, "rock crusher." With equal success he is now using Thordarson C. W. filament heating and plate supply transformers.

Today the Thordarson amplifying transformer is used in over thirty of the better standard makes of receiving sets, is sold by progressive dealers and jobbers everywhere and is providing sweet and undistorted music for thousands of radio fans the world over.

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TRANSFORMERS FOR EVERY PURPOSE

Super Transformer

(Audio Frequency)

(UNCONDITIONALLY GUARANTEED)



6 to 1 ratio	• •	\$4.50
3½ to 1 ratio	• •	4.00
2 to 1 ratio	• •	5.00

The Perfect Reproducer

Thordarson Audio Frequency Amplifying Transformers are built with one primal aim—perfect reproduction. The Thordarson Super Transformer is a product of the combined efforts of Thordarson engineers and nationally known tone experts and musicians.

Just as the reproducer on your phonograph is the most vital part of the instrument, so is the audio frequency transformer the very heart and soul of your receiving set. Upon your judicious selection of amplifying transformers depends the success or failure of your set as a musical instrument.

Over thirty of the leading receiving set manufacturers use Thordarson transformers as standard equipment in their product. They realize that the amplifying transformer question is of utmost importance, and have spared no effort in conducting thorough and exhausting tests for the very best musically, electrically and mechanically—And they have all chosen Thordarson.

The following paragraphs contain helpful information relative to the selection, installation, care, and methods of testing amplifying transformers.



TRANSFORMERS FOR EVERY PURPOSE

Selecting the Ratio

Thordarson Super Transformers are built in three standard ratios—6 to 1, $3\frac{1}{2}$ to 1, and 2 to 1. Use care in selecting the proper ratio transformer to fit your specific installation.

6 to 1 Ratio

This transformer should be used only in one stage amplifiers when maximum volume is desired. In two stages of 6 to 1 ratio the increase in volume over the lower ratios is very slight and a sacrifice in tone is noticeable.

$3\frac{1}{2}$ to 1 Ratio

This ratio is recommended for the average two stage amplifier (except in special cases listed in the next paragraph) and is the type most extensively used by the set manufacturers.

2 to 1 Ratio

The two to one ratio transformer is designed for use in two stage amplifiers in all cases where the detector output is great, and is therefore recommended for use with reflex and tuned and untuned radio frequency sets.

This type functions exceptionally well in the three stages of amplification. The voltage increase is great enough to give all the amplification desired and yet is insufficient to cause distortion by overloading the last vacuum tube.

Installing the Transformers

The accompanying illustrated diagrams clearly indicate the method of connecting Thordarson Super Amplifying Transformers. All transformer binding posts are plainly marked. No difficulty should be experienced in properly installing these transformers. It is well to remember, however, that all plate and grid leads should be kept as short as possible to prevent the possibility of howling through undesirable feedback.

All connections should be firmly made. A loose connection may result in unpleasant scratching or crackling.

Trouble "Shooting"

(These instructions apply on all makes of amplifiers)

Ordinarily no difficulty is experienced once an amplifier has been carefully assembled. If undue noises result they are easily traceable by following the instructions given herein.

(External Disturbances)

Unusual noises such as howls, buzzes and unusual crackling sounds may be due to causes outside the receiving set. This may be determined by disconnecting the antenna and ground. If the disturbance ceases it is caused by external interferences such as:

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TRANSFORMERS FOR EVERY PURPOSE

1. Oscillating receivers of neighbors.
2. Static or atmospheric disturbances.
3. Carrier waves and generator hums from broadcasting stations.
4. Transmitting stations using code.
5. Inductive disturbances from electric lighting circuits.

These noises may be eliminated or reduced by means of more selective receiving apparatus, wave traps, etc., or by changing the position of the antenna. The remedies vary with the cases and are too numerous to be mentioned in this booklet.

(Disturbances within the Set)

If upon disconnecting the antenna and ground the noises do not cease, the difficulty is within the receiver and may be caused by:

1. Loose connections in wiring.
2. Tube sockets not making good contact with prongs on base of tube.
3. Defective tube.
4. Plate or grid leads from transformer to tube too long.
5. Open circuit in apparatus used.
6. Run down batteries.

Test for Open Circuit in Amplifying Transformer

Occasionally a transformer winding will break causing an open circuit. Connect the primary of the transformer in series with the "A" battery and a pair of head-phones. Upon making and breaking contact a click should be heard. Do likewise with the secondary. If a click is not heard in both circuits the silent one is open. Transformer should be returned to the manufacturer for repair.

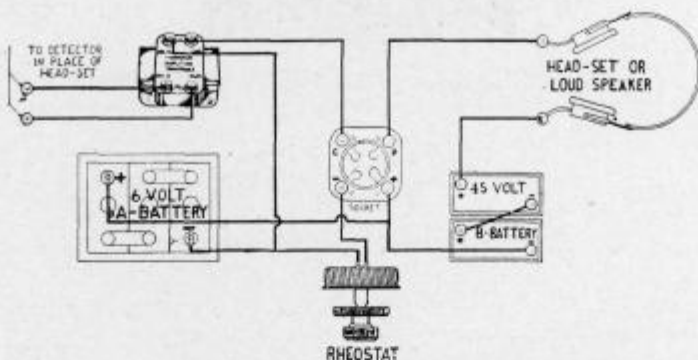
"Dangerous Circuits"

Some receiving circuits employ the use of a variable condenser between the ground or low potential side and the plate or high potential side. If the plates of this condenser should touch, a current of 30 milli-amperes (three times the normal carrying capacity of the transformers) is passed through the primary and the transformer will burn out. A shorted phone condenser across the detector B battery (22½ v) and the primary of the first transformer will have the same disastrous effect. Such circuits should be avoided whenever possible.

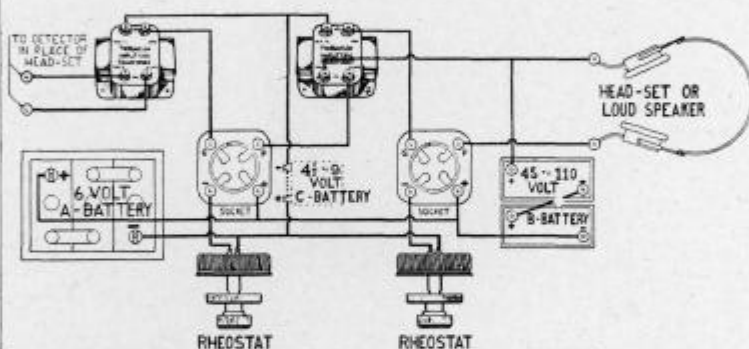
Three Stage Amplification

For this purpose we recommend the 2 to 1 ratio transformer. Three stage amplifiers sometimes have a tendency to howl. Care should be taken in wiring so that the plate and grid leads are as short as possible. The output leads of the amplifier and all loud speaking devices should be kept away from the detector to avoid regenerative coupling.

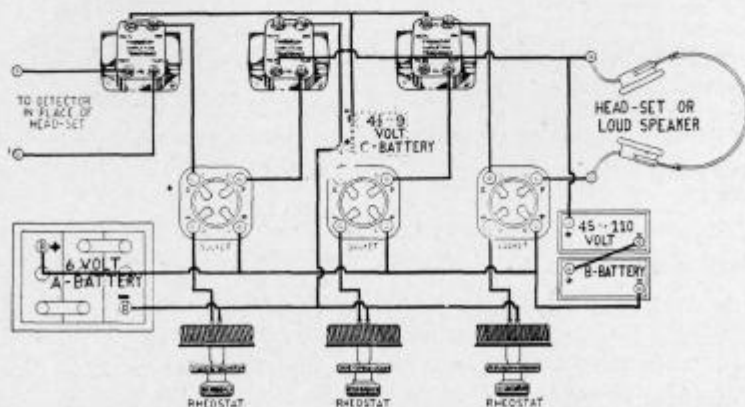
Cascade connection of the "B" battery with 45 volts on the first step, 90 volts on the second, and 110 volts on the third step will make amplifier less subject to howling.



ONE STAGE AUDIO FREQ. AMPLIFIER



TWO STAGE AUDIO FREQ. AMPLIFIER



THREE STAGE AUDIO FREQ. AMPLIFIER

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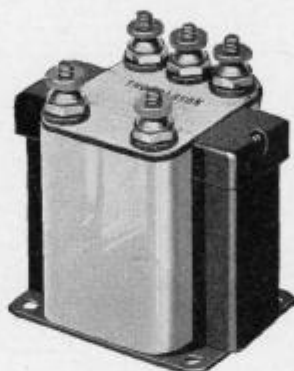
ELECTRIC MFG. CO.

TRANSFORMERS FOR EVERY PURPOSE

Power Amplifying Transformer

(Audio Frequency)

(UNCONDITIONALLY GUARANTEED)



Price per pair \$13.00

The Thordarson Power Amplifying Transformers (push-pull) are designed for use in third stage audio frequency amplifiers, to provide high power amplification for operating loud speaking devices.

Power amplification is positive insurance against third-stage distortion. Since two tubes replace the usual one the possibility of overloading tubes is reduced to a minimum. Thus signals are transferred free from distortion.

Thordarson Power Amplifying Transformers are well constructed electrically, and are capable of indefinitely carrying the additional load without breaking down.

In tonal purity these transformers equal the Thordarson Super-Audio Frequency Transformer whose rich quality and even amplification have made it the popular transformer of the day.



TRANSFORMERS FOR EVERY PURPOSE

Installation Instructions

(Read Carefully)

The accompanying diagram clearly illustrates the method of connecting the Thordarson Transformers in the Power Amplifying (push-pull) circuit. The dotted lines indicate optional connections to stabilize the circuit and prevent the possibility of howling.

For best results keep all plate and grid leads to the transformers as short as possible.

These transformers are designed to operate in the third stage of audio frequency amplification, and will give best results when preceded by two stages using the Thordarson $3\frac{1}{2}$ to 1 or 2 to 1 ratio transformers. It is possible to use power amplification in the second stage, although usually it is not necessary. **NEVER INSTALL POWER AMPLIFICATION IN THE FIRST STAGE; STRAIGHT AUDIO FREQUENCY AMPLIFICATION IS CHEAPER AND WILL GIVE BETTER SATISFACTION.**

Be sure your loud-speaker will carry the additional volume; many loud speakers will reproduce clearly only moderately loud signals, and when volume is increased beyond this point, the diaphragms rattle, and scratchy and distorted music results. **A PERFECT AMPLIFIER CANNOT CORRECT THE DEFECTS OF A FAULTY LOUD-SPEAKER.**

Construction

INPUT TRANSFORMER: Layer wound with No. 40 enamel covered wire. Step up ratio of $2\frac{1}{4}$ to 1. Center tap on secondary. Core, shell type, 7 mil silicon steel, cross section $\frac{3}{4}$ inch. Transformer completely shielded.

OUTPUT TRANSFORMER: Layer wound with No. 37 enamel covered wire. Step up ratio of 2 to 1. Center tap on primary. Core, shell type, 7 mil silicon steel, cross section $\frac{3}{4}$ inch. Transformer completely shielded.

Other Uses

1). **AS A STANDARD AMPLIFYING TRANSFORMER.** Use the input transformer, disregard center tap on secondary and connect as a regular amplifying transformer, according to the Thordarson Instruction Bulletin. This gives a step up ratio of $4\frac{1}{2}$ to 1.

2). **AS A COUPLING TRANSFORMER FOR LOUD-SPEAKERS.** A transformer may be used to advantage in coupling the loud-speaker to the amplifying circuit. This prevents the direct current

ELECTRIC MFG. CO.



For this purpose use the output transformer, disregard the center tap on the primary, connect the primary between the plate of the last tube and the positive "B" battery, connect the outside terminals of the transformer secondary to the terminals of the loudspeaker.

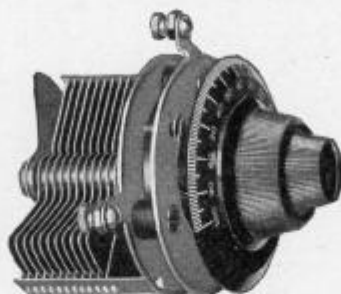
THORDARSON

ELECTRIC MFG. CO.

TRANSFORMERS FOR EVERY PURPOSE

Low Loss Adjustable Bearing Condenser

(UNCONDITIONALLY GUARANTEED)



The only **complete** low loss vernier condenser on the market. All movable and stationary plates are completely shielded against body capacity. Stationary plates spaced accurately by special, punched shell. Movable plates secured by ingeniously assembled comb separator brushing against bearing. Single metal bearing is double adjustable. Only the finest hard rubber used for insulation. Insulation kept away from center of static field, insuring minimum leakage even when at lowest capacity. Extremely low zero capacity.

Condenser Prices

VERNIER

With Knob and Dial

13 Plate Cap .00025 M. F.	\$3.50
23 Plate Cap .0005 M. F.	4.00
43 Plate Cap .001 M. F.	4.50

PLAIN

Without Vernier, Knob, or Dial

13 Plate Cap .00025 M. F.	\$2.00
23 Plate Cap .0005 M. F.	2.50
43 Plate Cap .001 M. F.	3.00

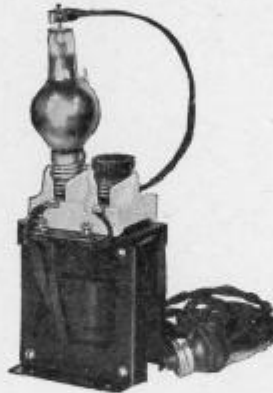
THORDARSON

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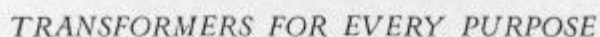
Battery Charging Transformer

(UNCONDITIONALLY GUARANTEED)



Price without Tube \$8.00

Insures a positive charge. Very quiet in operation. Charging rate averaging 2 amperes starting at approximately 3 amperes on a weak battery and decreasing as battery comes up to full charge. Cannot buckle plates or otherwise injure battery through overcharging. No vibrating parts to get out of order or cause a disturbing noise.



Station	City	Wave Length	Dial No. 1	Dial No. 2	Dial No. 3

THORDARSON'S

Electrical
Specialties





THORDARSON

ELECTRIC MANUFACTURING COMPANY



MANUFACTURERS OF

HIGH GRADE IGNITION COILS

JUMP SPARK

AND

MAKE AND BREAK

LARGE AND SMALL CAPACITY TRANSFORMERS

LABORATORY EQUIPMENT



Office and Works,
216-220 Jefferson Street,
Chicago, Ill.

Dash Coil With Switch



Type "L" Removable Vibrator

Our dash coil cases are of mahogany, lock-cornered, highly polished and finished with best grade of varnish obtainable for outdoor use. Made in both removable and non-removable vibrators.

LIST PRICE

Type "L" Removable Vibrator

Single Cylinder Dash Coil with Switch.....	\$11.00
Double " " " " "	14.00
Quadruple " " " " "	28.00
Sextette " " " " "	42.00

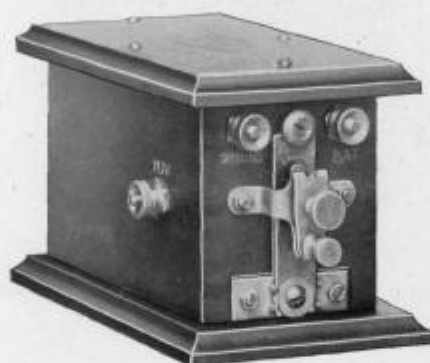
Type "J" Non-Removable Vibrator

Otherwise Same As Type "L"

Single Cylinder Dash Coil with Switch.....	\$10.00
Double " " " " "	13.00
Quadruple " " " " "	26.00
Sextette " " " " "	39.00

Box-Type Coil

For Marine and Stationary Engines



Above represents our standard box-type coil, case made of genuine birch, mahogany finish, with lock corners and transformer type construction, same as used in our automobile dash coil, equipped with extra large genuine iridium platinum contact points. Gives a hotter spark, consumes less battery power, is more efficient and costs less than any other coil manufactured.

Extra Secondary Post.....	\$ 0.50
Single Cylinder	4.50
Double ".....	9.00
Triple ".....	13.50
Quadruple ".....	18.00
Sextette ".....	27.00

Motor Cycle Coil



Made up in high-grade fibre cases and finely polished, construction is of the closed magnetic circuit type, same as used in our high-grade Automobile Dash Coils and can be furnished with flexible leads of any desired length. The case is completely filled with our special insulating compound, rendering coils water-proof and practically indestructible. Actual dimensions $4\frac{1}{4} \times 2\frac{1}{2}$ inches.

LIST PRICE \$5.00

Plug Switch.....50 cents extra

Will quote on coils with special leads on request.

Make and Break Coils

Particulars Regarding Construction

Occasionally we receive inquiries asking for specifications, size, weight and turns of wire in our coils, for comparison with other coils.



To give data of copper wire would be misleading as it would furnish no basis for judging comparative efficiency. A short explanation will make this clear.



What is required for doing the work is the kick or self induction in the wire, which, in other words, is the magnetism surrounding the wire. When an electric current flows along a straight wire of a certain length and weight, there is a small kick produced by the magnetism surrounding the wire when the circuit is broken. If the same length and weight of wire is wound into a coil or solenoid, the kick or induction becomes far greater, for the reason that each turn reacts on the neighboring turns. If a soft iron or laminated sheet is introduced into this solenoid, the magnetic path or magnetic circuit through and around the solenoid becomes better and the amount of magnetic energy that can be stored is proportionately increased. This will manifest itself in a proportionately greater induction and a heavier kick.

For these reasons it is plain that the most important problem in the design of a coil is its magnetic circuit. In its various forms the coil can be made to give a hundred times greater or smaller kick with same size of wire and same current in amperes.

The efficiency of the magnetic circuit to store and deliver energy depends:

First. On its section and length.

Second. The quality of its iron.

Third. The manner in which the iron is subdivided and its general shape.

We have made a special study of the magnetic circuit and have evolved a coil absolutely different from any hitherto used for gas engines. Coils will do more and better work with less battery power.

Cast Iron Make and Break Spark Coils



Note the mechanical construction of this coil; it is absolutely indestructible and impervious to moisture. This coil is designed for the trade that desires a highly efficient low priced coil.

The design of our make and break coils appeals especially to gas engine manufacturers and consumers who have experienced trouble owing to the old coil falling down, due to exposures to the weather, in fact, often even when enclosed in battery box, they will absorb sufficient moisture to short circuit. Our cast iron and steel case entirely eliminates this defect, as it safeguards and protects the winding and insulation and furthermore adds to the mechanical strength.

Dimensions

Base	4½"
Top.....	3½"
Height.....	3¾"
Weight	6 lbs.

Standard Windings

No. 18 .9 ohm.....	\$1.50
No. 16 .6 ohm.....	2.00

Can furnish above coils wound to any desired ohmage.

Steel Case Make and Break Spark Coils



No. 2 Make and Break

Enclosed in a sheet steel case and immersed in an insulating compound, making coil impervious to moisture and indestructible, fitted with brass terminals and binding post.

Dimensions

Length.....	5½"
Width.....	4 "
Height.....	3¼"
Weight.....	7 lbs.

Standard Windings

No. 2. .65 ohm.....	\$2.25
No. 3. .50 ohm.....	3.00

Can furnish coils wound to any desired ohmage.

Thordarson's Moisture-Proof Gas-Lighting and Gas Engine Coils



Above represents our standard steel case gas-lighting coil, designed to displace old type coils as illustrated above. These coils may also be used for ignition purposes on some types of gas and gasoline engines.

Due to the mechanical and electrical construction, coils may be installed in damp or wet places or exposed to the elements without effecting their efficiency. Coils are absolutely indestructible and impervious to moisture.

Construction is of the transformer type, such as used in our high-class gas engine coils. Its efficiency combined with its durability makes it superior to any coil on the market for this class of work. We use nothing but the best quality of material throughout.

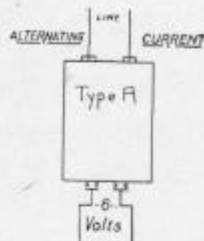
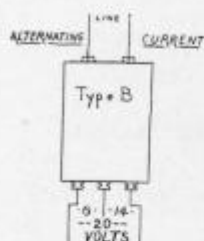
Dimensions of No. 8, 10, 12 Coils

Length.....	4¾"
Width.....	3¾"
Height.....	2¾"
Weight.....	5 lbs.

Standard Windings

No. 8 .41 ohm.....	\$1.40
No. 10 .67 ohm.....	1.60
No. 12 .87 ohm.....	1.80

Thordarson's Bell-Ringing Transformer



The Thordarson Bell-Ringing Transformer eliminates all battery troubles. Designed for ringing bells, buzzers, operating annunciators, burglar alarm systems, gas lighting systems and igniters on some types of gas and gasoline engines. It is operated at practically no expense.

It is designed to be connected on an alternating 110-volt 60-cycle circuit, as shown in the diagram accompanying each transformer, and may be used in a residence, hotel or office building, where an alternating current is employed.

Owing to its construction, the transformer is absolutely fire-proof and may be short-circuited indefinitely without burning or impairing its efficiency. When once installed, needs no further attention and will last a lifetime.

Type "A" Bell Ringer is suitable for all ordinary purposes. It is equipped with two secondary terminals and generates six volts.

Type "B" is furnished with three secondary terminals, as shown in diagram, and generates three different voltages—six, fourteen and twenty volts. Will ring bells up to 6 in. in diameter.

Dimensions Over All Type "A" and "B" Transformers

Length.....	7 $\frac{3}{8}$ "
Width.....	4 $\frac{1}{8}$ "
Height.....	3 $\frac{3}{8}$ "
Weight.....	8 lbs.

Type "A".....	\$6.00
Type "B".....	7.00

Standard: 110 Volts, 60 Cycles

Special windings 75 cents extra

Junior Bell-Ringer

Consumes
no
Current



Will Last
a
Life Time

We have added the Junior Bell-Ringer to our line of small capacity transformers to meet the demand of a low priced efficient bell-ringer, suitable for residence door bells, buzzers and all classes of light signal work. It has a 30% larger output than any other small capacity transformer. Will ring bells up to 4 inches in diameter.

For alternating current only. 110 Volts, 60 Cycles.

Dimensions

Length.....	6 "
Width.....	3 1/4 "
Height.....	2 "
Weight.....	3 lbs.

Price.....\$3.00

For heavy signal work and bells that require more power than is generated by our Junior, we recommend either our Type "A" or "B".

These transformers consume so little power that they will not register on an ordinary wattmeter and when properly installed we guarantee them to last a lifetime.

Thordarson's Nos. 1 and 2 Toy Transformers



Number 2 transformer generates 10 different voltages as described in diagram on opposite page, and is designed to operate any class of electrical toys, such as small fans, motors, miniature electric railway trains, ring bells, buzzers, light small lamps, operate Ruhmkorff or any other type of induction coils; in fact the different uses it may be put to are unlimited, depending only on ingenuity of experimenter.

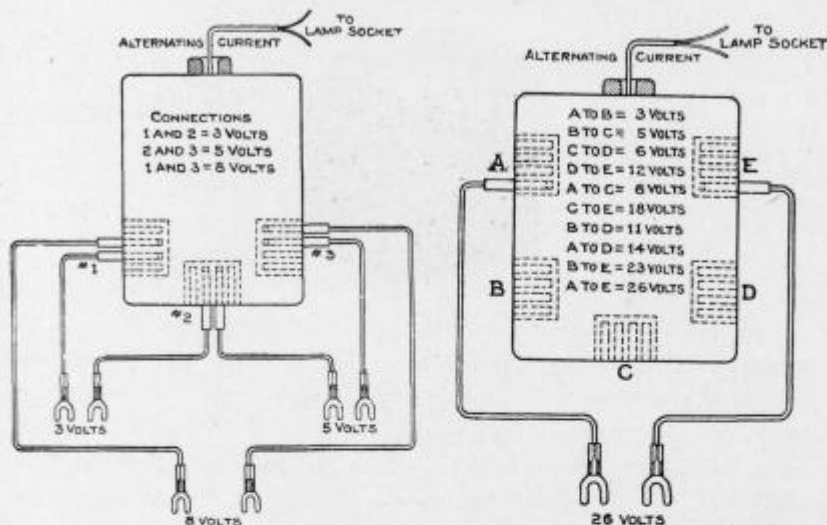
Number 1 transformer is designed to operate toys where the maximum power required is not more than 50 watts and potential of 8 volts. Any of the voltages on either number 1 or 2 transformer may be used singly or simultaneously, also two or more leads of the same voltage may be used at the same time. The device is indestructible and is not to be classed with batteries or gravity cells. It will not only afford amusement to the boy, but it will give him the fundamental working principles of electricity and will also prove of interest to the grown-ups.

The transformer is enclosed in a steel case and immersed in an insulating compound. Each transformer is equipped with a plug and eight feet of flexible cord, so that it may be attached to any lamp socket.

Number 1 transformer is furnished with three pairs of flexible cords, equipped with plug contacts on one end and brass terminals on the other, suitable for all necessary connections.

Number 2 is furnished with five pair of same. The above transformers will operate all classes of direct wound toy motors, with the exception of the permanent magnet type; this type of construction however has been rapidly growing in disfavor during the past three or four years, in fact, it is now about obsolete.

Various Circuits of Nos. 1 and 2 Toy Transformers



Output

Number 1 Toy Transformer	60 watts
Number 2 Toy Transformer	120 watts

Dimensions—Number 1 Toy

Length	5 "
Width	4 "
Height	3 1/4 "
Weight	8 lbs.

Dimensions—Number 2 Toy

Length	5 1/2 "
Width	5 "
Height	3 1/4 "
Weight	11 lbs.

110 Volts, 60 Cycles

LIST PRICE

No. 1 Toy Transformer	\$ 8.00
No. 2 Toy Transformer	10.00
Extra cords, per pair	.15

Christmas Tree Lighting Transformers



Designed to reduce 110 volts alternating current to 6 or 14 volts for lighting Christmas Trees or other decorative lights.

By using any of our Christmas Tree lighting transformers, expensive series wiring is eliminated. The lights are connected in multiple and in case one or more lamps burn out the other lights are not affected.

Type "M"—1 to 20 lights, 6 volts.....	\$7.00
Type "N"—1 to 20 lights, 14 volts.....	7.00

Dimensions

Length.....	5 "
Width.....	4 "
Height.....	3 $\frac{1}{4}$ "
Weight	8 lbs.

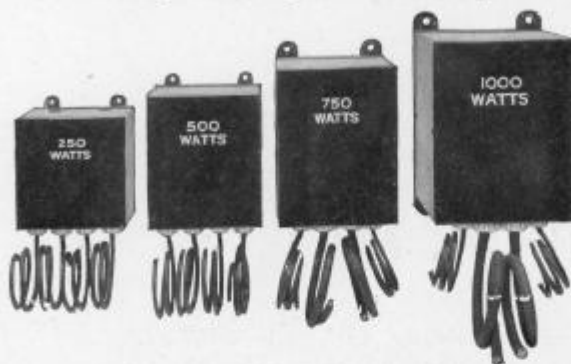
Built in two outputs

Type "O"—1 to 48 lights, 6 volts.....	\$9.00
Type "P"—1 to 48 lights, 14 volts.....	9.00

Dimensions

Length.....	5 $\frac{1}{4}$ "
Width.....	5 "
Height.....	3 $\frac{1}{2}$ "
Weight	11 lbs.

Thordarson's Multiple Lighting Transformer for Low Voltage Tungsten Lamps



Thordarson's transformers embody all the essentials of a perfect design, electrical, magnetic and mechanical. The construction enables the use of an exceedingly short, compact, magnetic and electrical circuit, reducing the weight to a minimum; for this reason they are especially adaptable for sign lighting as they may be mounted direct on the sign or any convenient place close to it.

Due to the mechanical and electrical construction, transformers may be installed in a damp or wet place or exposed to the elements without affecting their efficiency. They are mounted in black enameled steel cases and impregnated with our special insulating compound, making transformers impervious to moisture and practically indestructible.

Transformers can be used on circuits of 100 to 120 volts or 200 to 240 volts, with a ratio of 10 to 1 in the 110 volt line and 20 to 1 in the 220 volt line.

Transformers should always be placed between the switches and the lamps, in order that there may be no core loss during the day time. On large displays, which have quite a length of wiring, it is best to use several of the smaller sized transformers, and to distribute them so that the voltage drop in the various circuits will be small, and as nearly as possible the same. The shorter the low-voltage feed wires can be made, the better.

A transformer with a capacity larger than 1000 watts output, is not feasible for sign or other multiple lighting, as the installation of same would necessitate a change in the wiring, as the standard code wiring in use would not carry a larger amperage safely.

A saving of 50% to 70% 100 Lamp Comparative Current Consumption

Filament	Volts	C. P.	Wattage
Carbon	110	2	13
"	110	4	20
Tungsten	10	4	5

DIMENSIONS AND PRICE

150 watts.	5 x 4 $\frac{3}{8}$ x 3	weight 11 lbs.	\$14.00
250 "	5 $\frac{1}{2}$ x 5 x 4	" 16 "	16.00
500 "	6 $\frac{1}{2}$ x 5 x 4 $\frac{1}{4}$	" 24 "	18.00
750 "	8 $\frac{1}{4}$ x 5 $\frac{3}{4}$ x 5 $\frac{1}{8}$	" 35 "	20.00
1000 "	9 x 6 $\frac{1}{4}$ x 5 $\frac{7}{8}$	" 47 "	22.00

Stock winding primary 110 and 220 volts, 60
cycles, secondary 10 and 20 volts.

Thordarson's High Potential Transformers

Primary
110
Volts



Secondary
12000
Volts

Above transformer is as powerful as a ten inch induction coil, adaptable for wireless telegraphy, charging condensers, ozone generators and other experimental purposes. 250 watt capacity. Can be connected to any alternating current lamp socket. It is mounted in a black enameled metal case, impregnated in an insulating compound rendering the transformer impervious to moisture.

The high potential terminals are brass, protected with heavy rubber and equipped with safety spark gap. Our design of a transformer has a high efficiency, requiring only 3% to generate a full secondary potential without a load. Stock transformers are wound to operate on 60 cycle, 110 volts.

Standard Wireless

250 watt 12,000 volt.....	\$22.00
Dimensions	9"x6 $\frac{1}{4}$ "x5 $\frac{3}{4}$ "
Weight.....	45 lbs.

High Potential Transformer



Our High Tension Transformers for laboratory and experimental work are unequalled. Transformers are mounted in large and beautifully finished quarter-sawed oak cases. They are constructed with four primary terminals and wound to be operated on either 110 or 220 volts alternating current at any frequency of from 60 to 130 cycles. The secondary coils are wound with the best silk insulated copper wire; the complete transformer is immersed in a special grade of insulating oil which has a flashing point of 300 degrees Fahrenheit. The best insulation is used throughout.

In the design special provision is made to guard the secondaries against shortcircuiting from high potential surges or oscillations, as may occur from condenser circuits.

The high potential terminals are brass, protected with heavy rubber that passes into the oil.

We carry these Transformers in stock from 1 to 5 kilowatts capacity, with secondary potential varying from 5,000 to 60,000 volts. We build same to order also, of any capacity and any secondary potential desired.

We wish to add that the Jury of Awards at the Louisiana Purchase Exposition conferred on us a Gold Medal for High Potential Transformers.

Price.....\$65.00 to \$145.00

Quotations on Request.

**ELECTRICAL
LABORATORY
and
DEMONSTRATION
APPARATUS**



THORDARSON

ELECTRIC MFG. CO.

CHICAGO

IN trying to write a short introduction to this catalog, I find that I cannot do better than quote an essay printed one hundred and thirty-five years ago by one of the great English educators, Mr. George Cadogan Adams, a distinguished scientist. This is a photographic copy of pages 437 and 438, second edition, of his "*Lectures on Electricity*," published in 1797. There he has expressed all the fundamentals of design in a masterly manner that has never been better done in the English tongue.

C. H. THORDARSON.

DIRECTIONS

FOR THE

CONSTRUCTION

OF AN

Electrical Apparatus.

IN the construction of your electrical apparatus, it should be the first object of your endeavours to avoid all waste of power, or that extravagance in the consumption of time, of talents, and of means, which takes place when your movements are too slow, too numerous, or too complicate; when your ingredients are unnecessarily expensive; when you operate on too small a scale, and thus fall into errors which are corrected only by a repetition of efforts, or when, by working on too large a scale, each result becomes the fruit of excessive labour.

F f 3

An experimentalist, by avoiding all waste of power, or by cultivating that skill which does neither too much nor too little, escapes from some of the most tiresome incumbrances of his pursuit. His apparatus will be simple, and when his results disappoint him, he will have but few parts to examine as the sources of his error. His apparatus will be cheap; and while his own powers are thus enlarged, he increases the probability that other men's endeavours will co-operate with his own. His apparatus will be permanent, and the repetition of innumerable and tedious labours will be unnecessary. His apparatus will be easily understood, and consequently its possible improvements will be the more obvious, and the more likely to be realized. In fine, like all the expedients of wisdom, those which he applies to his own peculiar circumstances will be fully adequate to their demands, and will squander nothing which may be useful in future exigencies.



Thordarson Electric Manufacturing Company

500 West Huron Street

Chicago

Our factory is the most complete, up-to-date manufacturing unit of its kind in the world. In it each product is fabricated from basic materials and assembled according to approved designs. Quality and precision are controlled from start to finish. Automatic machinery and highly developed processes contribute to the excellence of Thordarson products. Over thirty-six years have been devoted toward building up an unbroken record of sincere dependable service.



Gold Medal awarded at the
Louisiana Purchase Exposition, St. Louis
in 1904 for high voltage transformers.



Gold Medal in recognition of Thordarson superiority
awarded at the Panama Pacific International
Exposition, 1904. San Francisco, 1915.

The Thordarson Electric Manufacturing Company has always pioneered in laboratory research and methods. Over thirty years ago Thordarson designed and manufactured extensive electrical demonstrating apparatus for the laboratory. Many of these flexible units are in constant use in universities and colleges throughout the country.

We now offer modern laboratory and demonstration apparatus which incorporates all of the good points of the original units and many ideas newly developed.



TYPE T-5261

Magnetic Circuit (Double)

The magnetic circuit is the foundation unit around which we have built many flexible parts for laboratory and commercial use.

The double magnetic circuit is of the core type construction with a removable top yoke or armature. The proportions are pleasing and the size generous. Simplicity and flexibility are paramount.

The U shaped stampings are made of high grade silicon transformer steel carefully assembled and mounted in a broad and rigid casting. The yoke is also laminated and is rigidly clamped. It is provided with pins for quickly aligning it in place on the pole faces.

The whole unit is carefully finished in attractive green and black.

This magnetic circuit has the proportions of a two kilowatt transformer. The legs measure $2\frac{3}{8}$ inches by $2\frac{3}{8}$ inches in cross section. The total length of the magnetic circuit is 33 inches. The members of the circuit are square for simplicity of calculations. The total weight is 84 pounds. The length is $12\frac{3}{4}$ inches, the width $6\frac{1}{4}$ inches and the overall height when assembled 12 inches.



TYPE T-5400

The Magnetic Circuit (Single)

This magnetic circuit is a single inverted T laminated structure and is designed primarily to illustrate the action of A.C. or D.C. magnets.

It is constructed similar to the double leg magnetic circuit described on the preceding page. The T shaped laminations are firmly assembled in a cast iron base. It is attractively finished in green and black.

The important dimensions of this unit are exactly the same as the double leg circuit in order that the auxiliary parts of each may be interchangeable. The center leg measures $2\frac{3}{8}$ inches by $2\frac{3}{8}$ inches. It weighs 40 pounds.

Length— $11\frac{7}{8}$ inches.

Width— $6\frac{1}{4}$ inches.

Height— $9\frac{1}{2}$ inches.



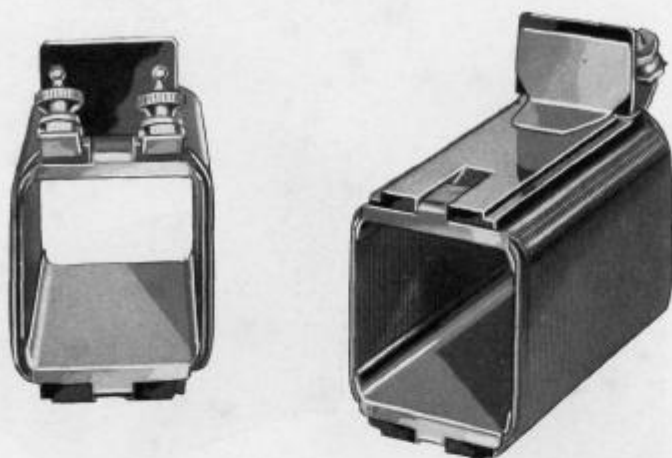
TYPE T-5401
The Magnetic Circuit
(Triple)

This magnetic circuit has three legs upon which to assemble apparatus for single, polyphase or D.C. circuits.

Its construction is similar to the magnetic circuits described on preceding pages. The E shaped laminations, which make up the core, are stamped from single sheets of high silicon transformer steel without having any joints and assembled into the heavy cast iron base. The removable top yoke or armature is ground on two faces so that either side can be used. One face is recessed at the center in order that in certain applications an air gap will be formed between it and the center leg. The yoke is provided with pins for aligning it on the pole faces.

The unit is finished in black and green.

The leg dimensions of this unit are the same as those of the other magnetic circuits previously described in order that parts of each may be interchangeable. Each leg measures $2\frac{3}{8}$ inches by $2\frac{3}{8}$ inches by $6\frac{1}{2}$ inches long. The window space between legs is $2\frac{3}{8}$ inches wide. The length of this magnetic circuit overall is $15\frac{1}{2}$ inches. The height assembled is 12 inches and the width $6\frac{1}{4}$ inches. The weight complete is 106 pounds.



TYPE T-5262

Primary Coils for Alternating Current

The primary coils are designed for use with any of the magnetic circuits. They can readily be assembled or removed by simply slipping them over the core of the magnetic circuit. The coils can be used either singly or in combinations. Each is carefully constructed to withstand constant use.

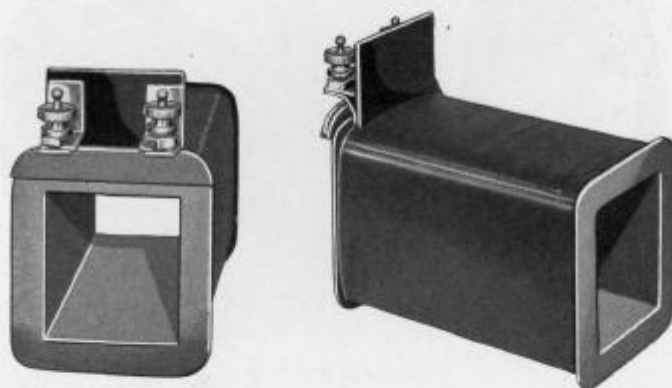
The coils are wound with two layers of enameled wire, the greater part of each layer exposed to the air to give the maximum of cooling action. This is accomplished by winding a self-supporting coil around two copper plates which are placed inside the coil but outside of the magnetic circuit proper. These copper plates serve as guides for assembling or withdrawing the coils on the magnetic circuits. The plates also serve as a support for the two heavy terminals. An angle plate fixed to the outside of the coil over the terminals prevents accidental contact with the terminals causing a short circuit.

Each coil has 110 turns. (One turn per volt when used on 110 volts.)

We pride ourselves in our ability to wind these self-supporting coils of heavy wire without subsequent forming or hammering to shape. It is accomplished by the use of special patented winding machinery which guides the wire straight, flat and accurately onto the square form without stretching.

Bakelite only is used on all sheet insulation under mechanical strain.

Each weighs $4\frac{1}{2}$ pounds.



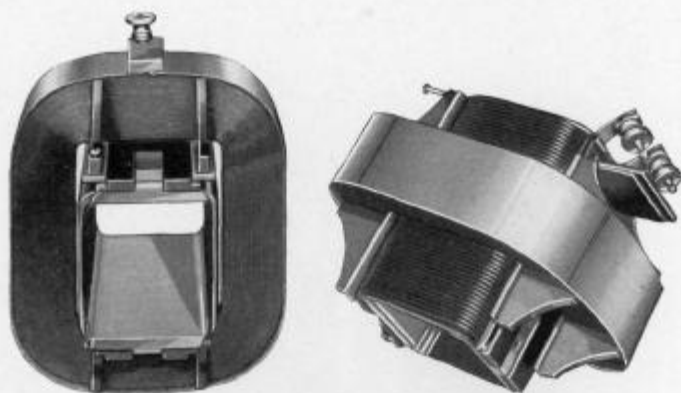
TYPE T-5263

Direct Current Coils

The direct current coils are spool wound coils especially designed for use on a direct current source. With their use a powerful direct current field can be produced.

These coils are wound on a square copper form which may be slipped over the core of any of the magnetic circuits. A continuous brass form is used so as to cut down the inductive surge resulting from the breaking of the direct current circuit. Also, should the coils accidentally be placed on a core energized with alternating current, the continuous form acts as a short circuiting turn eliminating the possibility of a dangerous voltage being developed by the many turns of this coil.

The heavy terminals are carefully protected against accidental contact by a shield placed over them.



TYPE T-5265

Secondary Coil

The high voltage coils are designed to slip over the A.C. primary coil to form the secondary of a practical high voltage, step-up transformer.

The coil is layer wound and carefully insulated. When in place, over the primary on the magnetic circuit, the inside or start of the winding is grounded to the core. A heavy metal band is placed over the outside of the coil to serve as an electrostatic shield and to guard the coil from mechanical injury. The winding is centered and securely held by bakelite ribs which are fastened to brass rails. The rails slide in slots provided for them on the outside of the primary winding.

This coil delivers 20,000 volts when assembled with the primary coil energized with 110 volts 60 cycles. Two of the secondaries may be used on the double magnetic circuit to obtain 40,000 volts. A $\frac{1}{8}$ " shield of mica is placed between the two coils to prevent arcing. The conductor used is ample to carry 50 milliamperes. The open and exposed construction eliminates the possibility of excessive temperatures.

The coil is carefully vacuum impregnated and finished in black with the outer band chromium plated.

The coil measures 7 inches by $9\frac{1}{2}$ inches in its extreme dimensions.



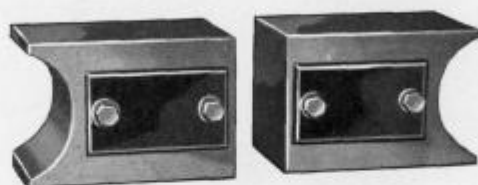
TYPE T-5402

Surge Damping Coil

These auxiliary coils are useful in the high voltage leads of the assembled apparatus. They damp out and dissipate surges and objectionable high frequency currents and prevent injury to the transformer windings.

Carefully insulated turns are wound on a bakelite tube inside of which is placed a copper tube. Suitable terminals make the coils readily adaptable.

Each coil measures 6 inches in length and is $2\frac{1}{8}$ inches in diameter.



TYPE T-5403

Pole Pieces

These laminated pole pieces are constructed in the same sturdy manner as are the Magnet Circuits. They have many applications in both A.C. and D.C. fields.

High silicon transformer steel is punched, assembled and clamped in perfect alignment. One end is square and the other semi-circular. Finished in black.

Each is $4\frac{1}{4}$ inches long by 3 inches wide by 3 inches high. The weight of each is 9 pounds.



TYPE T-5404
Rotating Discs

The rotating discs are used to illustrate the action of alternating current fields.

They are constructed of heavy aluminum with a bearing at the center of each disc. They are pivoted to the frame in such a way that the discs overlap, yet do not touch each other. A wooden handle is provided.

Each disc is 6 inches in diameter and $\frac{1}{8}$ inch thick.



TYPE T-5405
Ball and Stand

The pivoted aluminum ball and stand is used to show the properties of an alternating current field.

The ball is hollow and has diametrically placed recesses to serve as bearings. The ball may be removed from the stand and used as a free sphere. Being hollow, it floats in water.

It is carefully machined to be an exact sphere. It is 4 inches in diameter. The metal base is slotted to eliminate the possibility of distortion of the magnetic field.

Finished complete as shown.



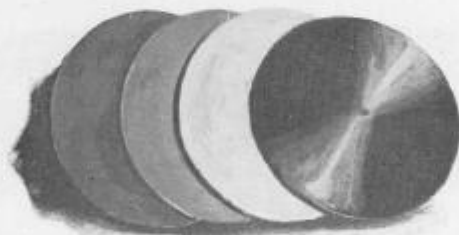
TYPE T-5406

Lamp or Exploring Coil

A coil of many turns constructed so that a suitable incandescent lamp may be screwed into contact with its two terminals and permit a most vivid demonstration of the strength and direction of an alternating current field in various positions.

The coil is carefully form wound and impregnated. It is taped and water-proofed. The lamp base is of special construction and is included.

The dimensions of the assembly is 5 inches in diameter by $4\frac{1}{2}$ inches high.



TYPE T-5407

Discs

Flat discs of various materials to illustrate the magnetic attraction or inductive repulsion of alternating current fields.

Two discs are constructed of steel and two of copper, each 6 inches in diameter and $1/16$ inch thick. The volume of each disc is identical in order that the magnetic or inductive effect on each may be the more clearly demonstrated. Both steel and copper discs are chromium plated and have the same outward appearance.

Furnished in sets of four.



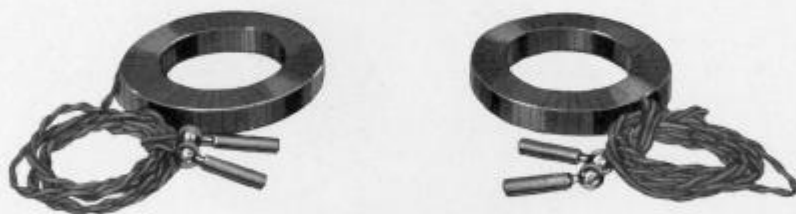
TYPE T-5408

Copper Ring

A continuous ring made of copper to illustrate the properties of an alternating current field.

This ring is made of solid copper of generous proportions in order that it may withstand the enormous induced currents set up without undue heating.

It is $5\frac{1}{4}$ inches mean diameter. The copper conductor itself has a diameter of $\frac{1}{2}$ inch. It weighs 1 pound.

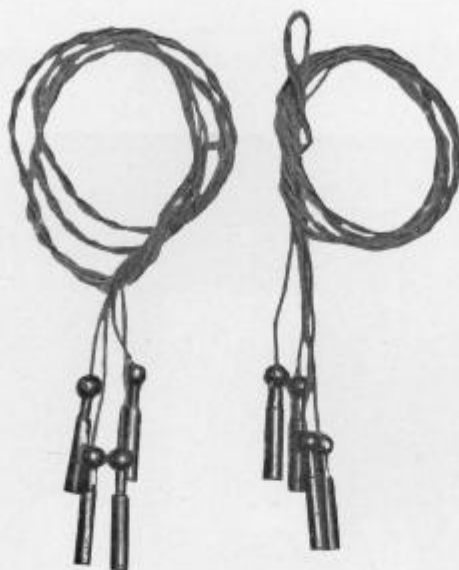


TYPE T-5409

Direct Current Exploring Coil

A round, paper section coil designed with characteristics such that 110 volts direct current may be applied to its terminals. When so energized, it can be used to demonstrate attraction and repulsion. This coil is also very useful in demonstrating lines of force by means of iron filings.

The coil is $6\frac{3}{4}$ inches in diameter.



TYPE T-5410

Cords and Connectors

Insulated, flexible conductors provided with ball socket connectors for convenient use with the many items of laboratory apparatus. The connector is carefully sheathed within a fiber tube which, when drawn toward the ball end, permits the socket to expand and be inserted or withdrawn from terminal.

Finished with cords 5 feet long.



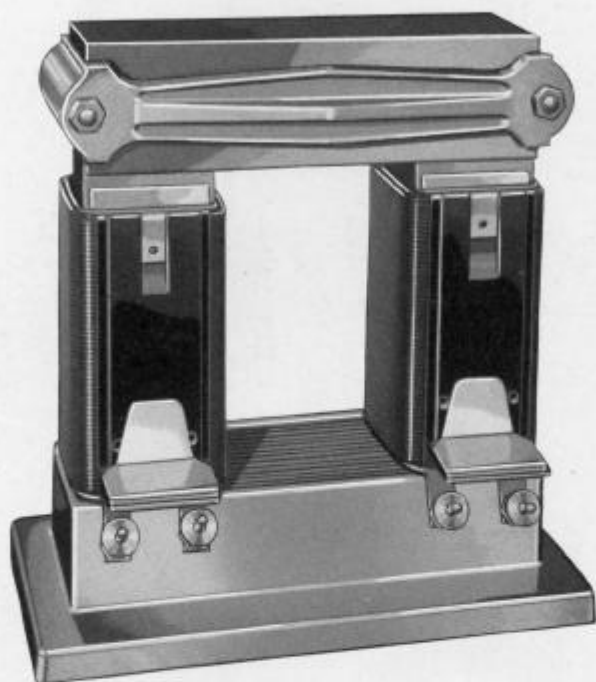
TYPE T-5411

Double Pole Double Throw Switch

A small switch of 10 ampere capacity. A bakelite baffle protects the blade and jaws against accidental contact and prevents possible arcs from jumping from one part to the other.

Size— $5\frac{1}{2}$ inches by $3\frac{1}{4}$ inches by $2\frac{7}{8}$ inches high.

ILLUSTRATION OF LABORATORY SETUP



Magnetic Circuit with A.C. Coils

Here we show the A.C. primary coils (T-5262) assembled on the magnetic circuit (T-5261) with the yoke in place. This illustrates the simple core type transformer. Using one coil as a primary on 110 volts 60 cycles, the exciting current is less than 1.5 amperes and the core loss 35 watts. The other coil may be used as a secondary or may be connected in series or multiple and used as part of the primary.

ILLUSTRATION OF LABORATORY SETUP



High Voltage Transformer

The illustration of the assembly of the magnetic circuit, two primary coils and two high voltage secondary coils (T-5265) This assembly provides a transformer which, when operated on a 110 volt 60 cycle circuit, is capable of delivering 40,000 volts. The inside of each coil is grounded which gives a transformer with a grounded mid point secondary. A suitable mica barrier is placed between the two sections of the secondary.

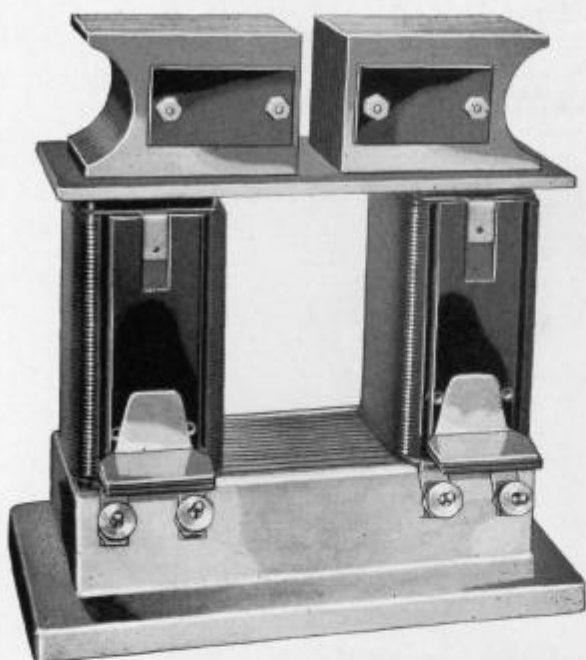
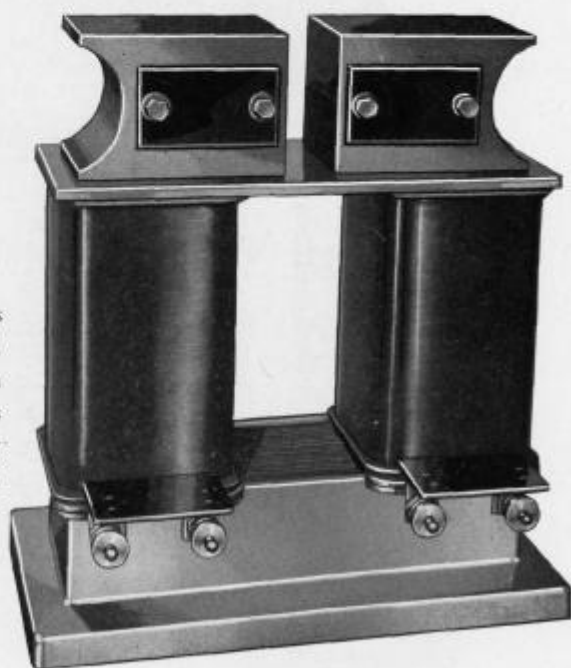


ILLUSTRATION
of
**Pole Piece
Assembly**

The laminated pole pieces (T-5403) can be assembled on the magnetic circuit with either the primary coils energized with alternating current or with the direct current coils (T-5263) energized with direct current.



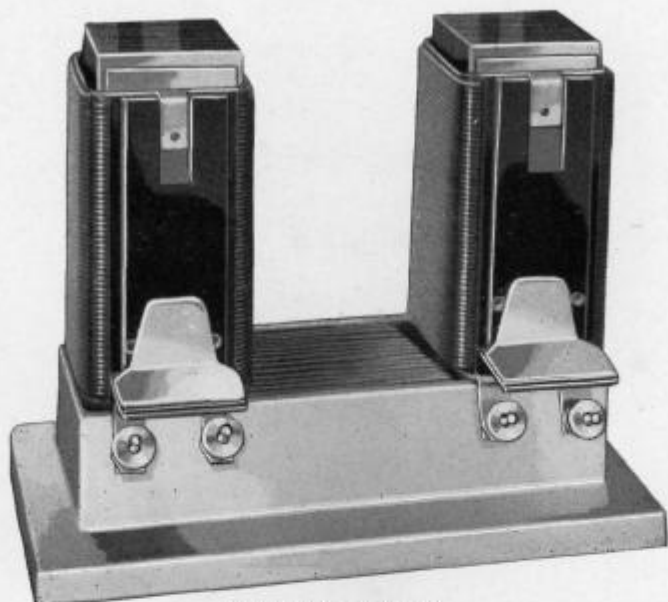


ILLUSTRATION
of
Coil Assemblies

The magnetic circuit can also be used as an open core unit with either the A.C. or D.C. coils. When used on alternating current, it is desirable to have some regulating device to limit the amount of current flowing through the winding. This can best be done by using the regulator illustrated on Page 34.

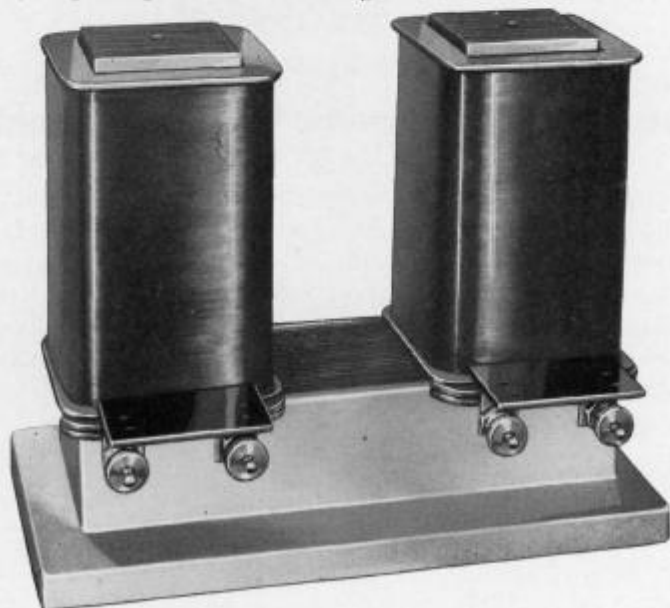




ILLUSTRATION
of
The "Single" Magnetic Circuit Assembly

Here we illustrate an experiment using the "single" magnetic circuit with an A.C. primary coil and the lamp exploring coil. The lamp and coil are immersed in a jar of water and placed over the pole face. When energized with alternating current, a sufficient voltage is generated in the lamp coil to light the lamp brilliantly. A current limiting device should be used in series with the coil when used on 110 volts.



ILLUSTRATION
of
Shading Plate and Base

Figure 22 shows a similar experiment but with the hollow aluminum ball floating in the water. The ball is caused to rotate by distorting or shading the magnetic field. Half of the pole face is covered with a piece of $\frac{1}{8}$ inch thick aluminum sheet to cause field distortion.

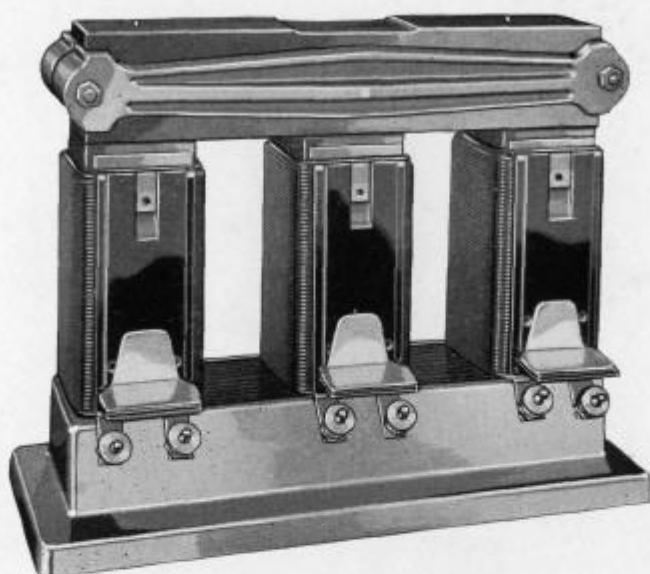


ILLUSTRATION
of
“Triple” Magnetic Circuit Assembly

Using the magnetic circuit illustrated on page 10, we show the assembly of an A.C. primary coil on each leg. The yoke is assembled with the recessed face up. This gives a three-phase transformer assembly around which many experiments can be performed.

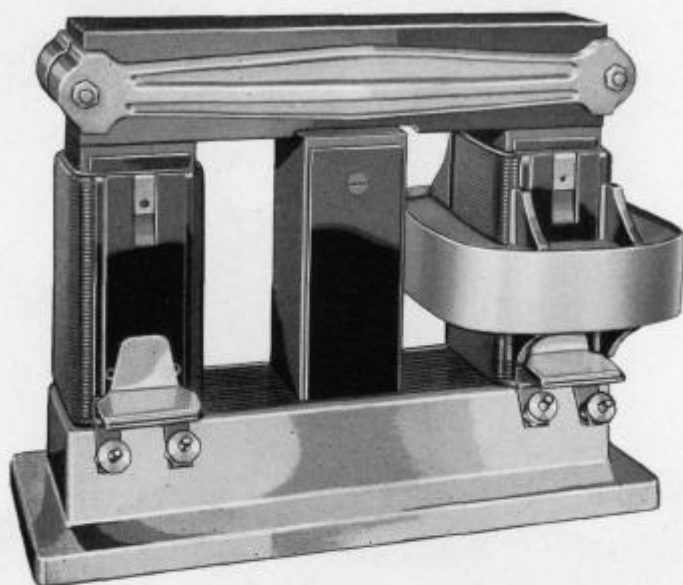
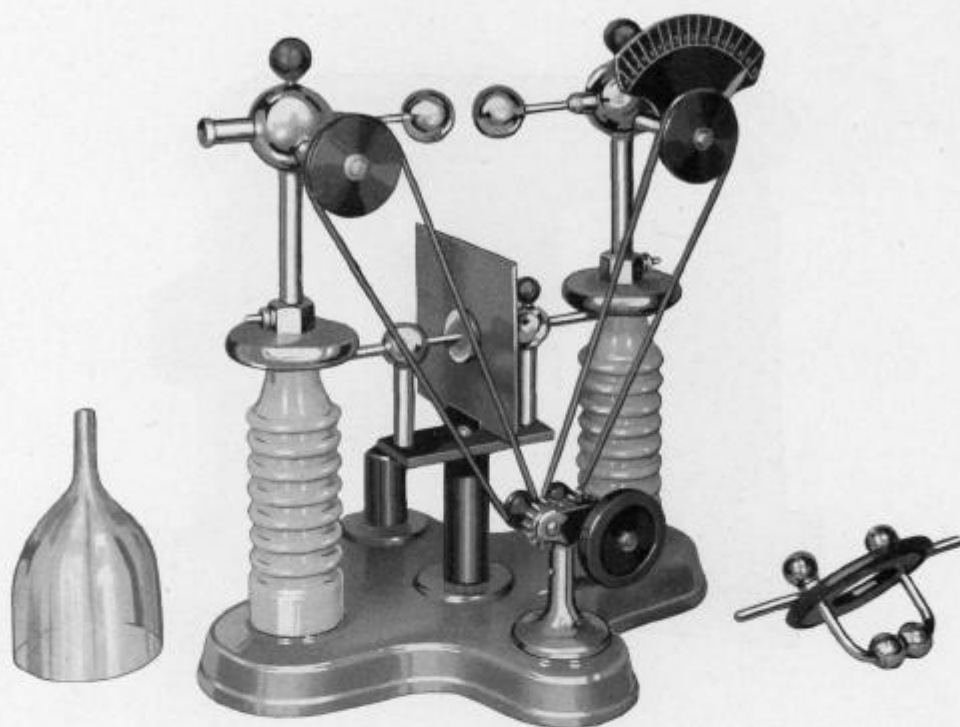


ILLUSTRATION
of
A "Single" Phase Transformer Assembly

Using the "Triple" magnetic circuit and assembling the parts as illustrated, gives a single phase transformer with a magnetic shunt path. The yoke, in this case, is assembled so that the recessed portion forms an air gap between the center leg and the yoke. The primary coil is assembled over one outside leg and the high voltage secondary coil over the other outside leg. An A.C. primary coil forms the foundation for the high voltage secondary coil and can be used as a voltmeter coil for measuring by ratio the high secondary voltage. The center leg forms a magnetic shunt which will limit the amount of energy in the secondary coil to values which will not produce a destructive arc.

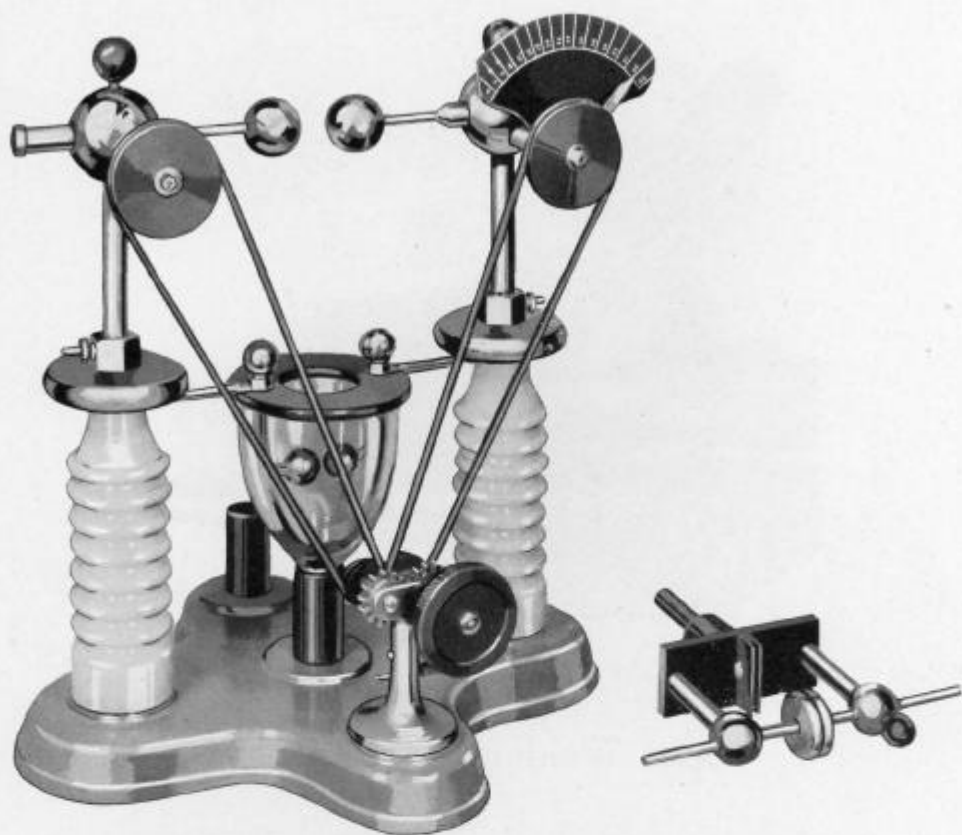


TYPE T-5412

Sphere Gap Testing Frame

Test apparatus for measuring high voltage with provisions for testing for the breakdown of insulation and insulating oils. The sphere gap is one of the most accurate ways of measuring high potentials.

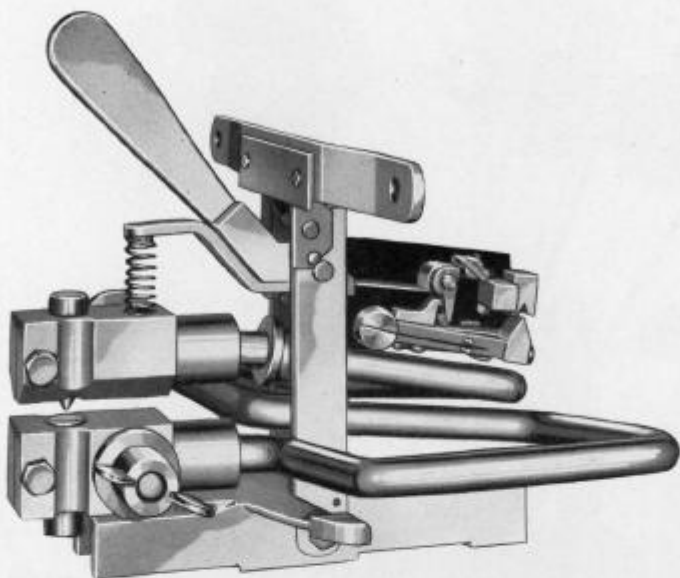
Two heavy porcelain insulators fastened to a heavy cast iron base serve as supports for the two spheres. The spheres are exactly 3 centimeters in diameter. Each sphere is capable of being moved in a horizontal direction by means of belts and an insulated hand wheel. With one sphere locked in position, the other may be moved to the point of breakdown and the voltage measured directly by the pointer on the calibrated scale attached to the right hand terminal.



An attachment for measuring the breakdown of sheet insulation is supplied which is arranged so that the test sample is held in a vertical position to permit the free circulation of ionized air from both sides of the sample. The sample is held in position between the round edge, flat electrodes by means of a slight spring pressure. The stem of the holder fits into a socket fastened to the base frame.

Another attachment consists of a glass cup provided with a bakelite cover and suitable spherical electrodes for the testing of insulating oils. The electrodes are adjustable and can be spaced accurately. The clear glass cup permits observation during the test.

Furnished complete with the attachments described above. Weight—15 pounds. Dimensions— $12\frac{1}{4}$ inches long by $10\frac{1}{2}$ inches wide by 14 inches high.



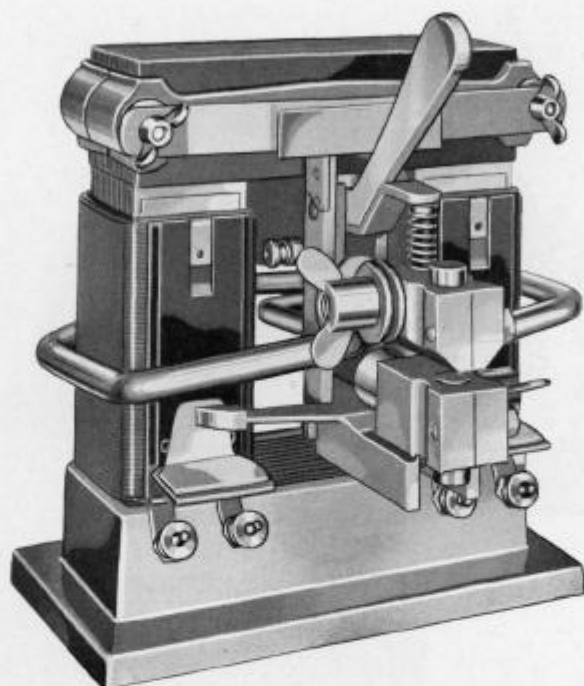
TYPE T-5264

Spot Welding Attachment

A practical spot welder of real commercial value as well as a laboratory apparatus attachment of unusual design.

This unit is designed to be attached to the double magnetic circuit assembly. Its construction can well be determined from the illustrations.

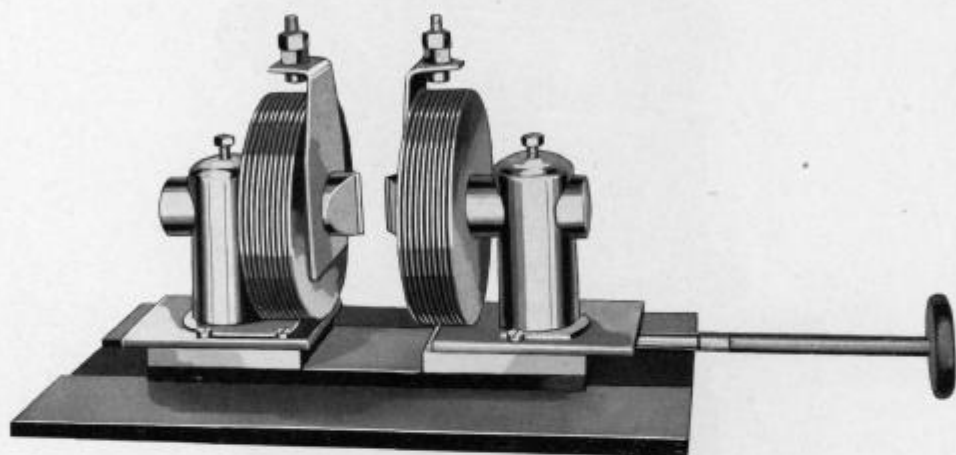
The ends of the heavy copper conductors terminate in solid electrode holders. The electrodes are adjustably mounted in an accessible position. A primary snap switch, to close and open the primary circuit, is mounted on the arm of the hand operated lever. This switch is timed so that three distinct operations are performed during welding, first the downward movement of the handle moves the electrode points into contact with the metals to be welded, second the primary circuit is closed through the time switch and third the primary circuit is broken by a quick snap action of the time switch before the lever handle has been raised.



Each of the electrode holders is provided with a heavy, copper terminal fitted with a thumb nut to which a lead can be attached for other heavy current work in the laboratory.

The welder has a maximum secondary capacity of 2000 amperes at 2 volts. It is recommended that a 3 K.W. regulator, as a means of primary voltage adjustment, be used in series with the primary coils in order to secure control of the welding temperature.

Complete as shown. Weight—17 pounds.

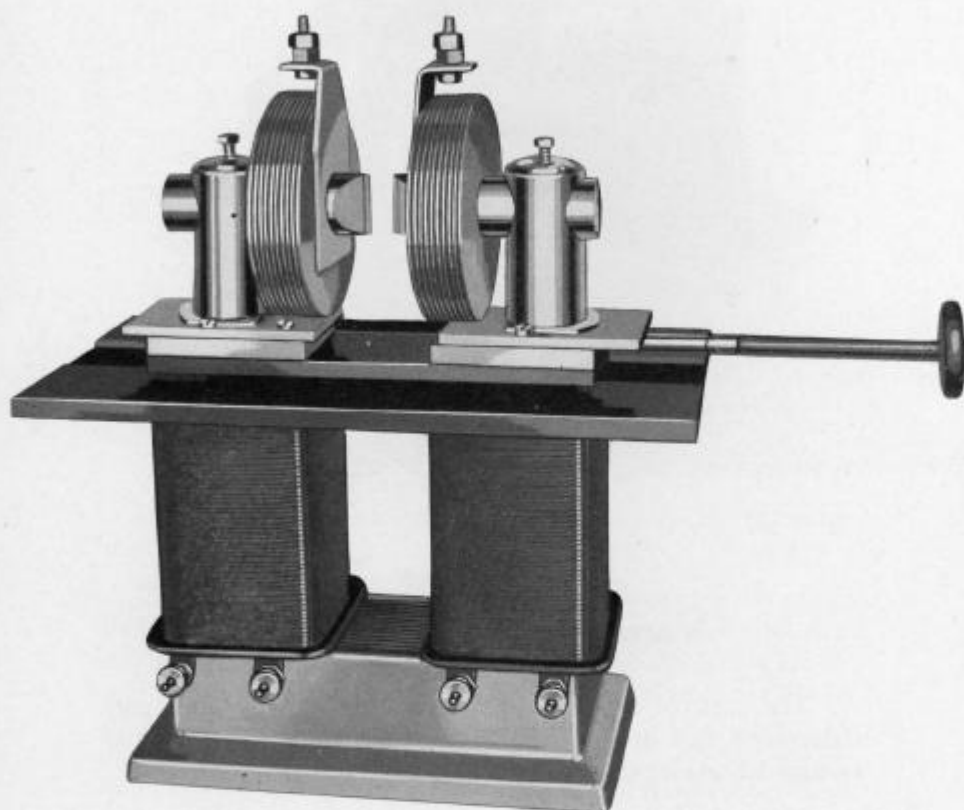


TYPE T-5413

Spark Gap

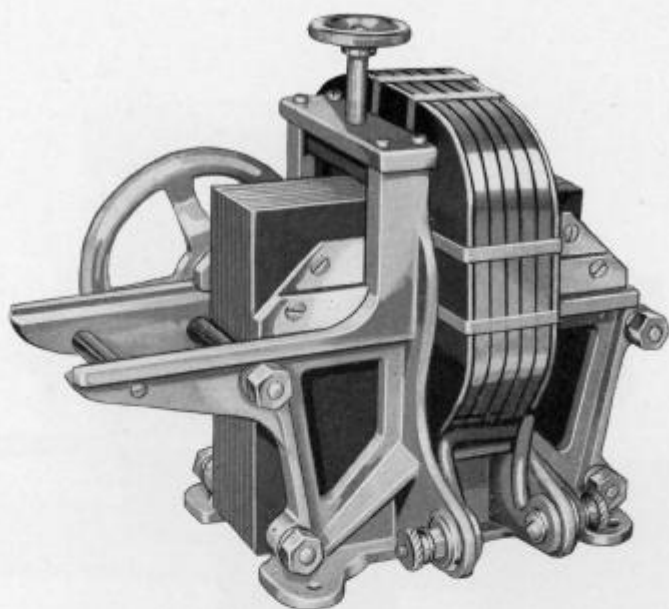
A spark gap of generous proportions, designed to handle considerable current.

The electrodes are mounted in a horizontal position on two heavy metal supports. The gap may be adjusted by turning an insulated hand screw which moves one electrode. The gap is mounted on a heavy bakelite base to insulate it from ground. Each electrode is provided with a number of radiating discs and is faced with an edge of tungsten. Heavy terminals are provided for making the necessary connections.



This spark gap is designed so that it may be mounted on the double magnetic circuit as illustrated which, when the coils are energized, will provide the gap with a magnetic blow out.

The gap, without the adjusting screw, measured 16 inches long by 8 inches wide by $9\frac{1}{4}$ inches high.



TYPE T-4090

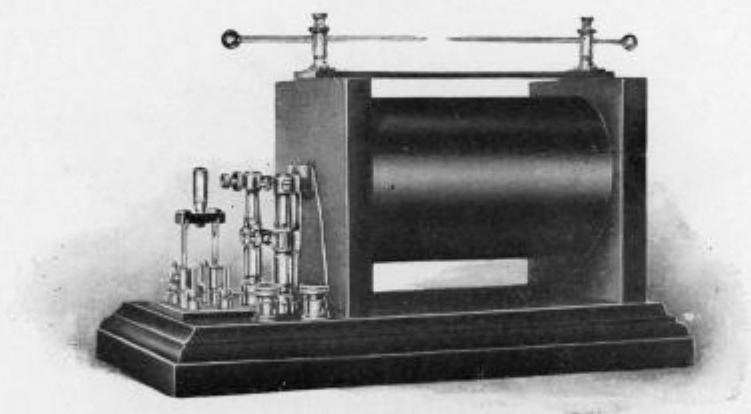
Variable A.C. Regulator

The variable regulator is a hand operated movable core inductance used in series with 110 or 220 volt lines to control various laboratory circuits.

The special shaped laminated core is designed so that it may be moved in and out through the coil to complete or vary the magnetic circuit surrounding the coil and thus vary its impedance in the circuit. The core is shaped to give a straight line variation over its entire range. It is operated by a hand wheel conveniently located on the side of the regulator. A clamp on the top permits the core to be locked in any position desired.

This regulator is especially adaptable to the primary regulation of the potential or heavy current apparatus described in preceding pages. It is indispensable for general laboratory use and thousands are now in use. It is rated at 3 K.W.

Dimensions—12 inches long by 9 inches wide by 10 inches high. Weight—60 pounds.



Rhumkorff Coils

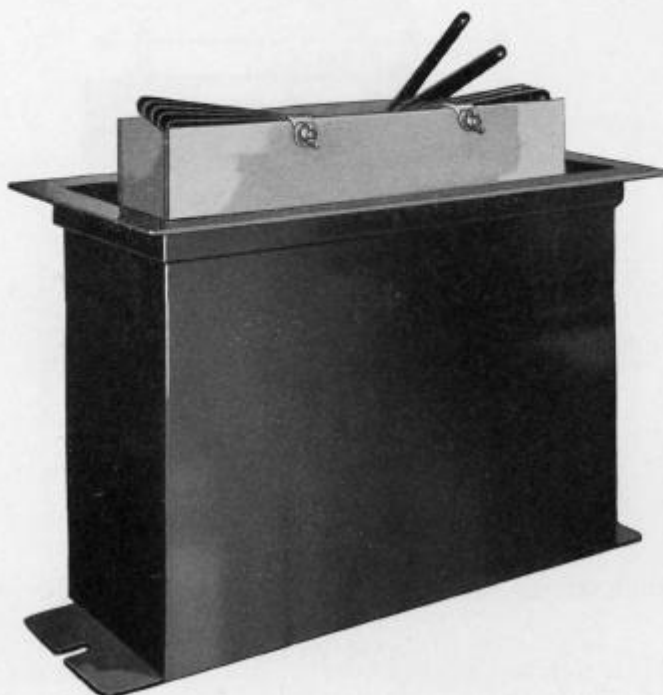
High quality Rhumkorff or induction coils for laboratory use.

These coils are designed to be operated from a 6 volt storage battery. The heavy nickel plated vibrator is provided with three adjustments, one on the hammer, another on the spring tension and a third on the contact screw. This permits a wide variation of interrupter frequency and insures constant operation. The contact points are of a special tungsten metal and give long life. The coils are sealed in a carefully constructed hard rubber covering and are vacuum impregnated. A double pole double throw switch in the primary circuits permits quick change of polarity. The secondary is provided with an adjustable needle gap.

Finished in walnut and black.

Furnished in two sizes, a 3 inch and a 6 inch secondary spark.

SIZE	TYPE No.	DIMENSIONS
3 Inch	T-2226	15½" x 8½" x 10"
6 Inch	T-2315	18⅞" x 12¾" x 14½"



High Voltage Oil Filled Condensers

We supply two types of high voltage condensers, one variable and the other fixed. Both are rated at 20,000 volts.

A special high grade mica sheet dielectric is used. The plates are of sheet aluminum and are separated by a corrugated sheet which permits free circulation of the insulating oil. This feature eliminates any hot spots on the dielectric and free oil is in contact with every square inch of the metal plates. The units are carefully clamped and assembled in a heavy steel container.

The variable condenser is provided with a series of contact arms which can be moved into contact with the various plates.

The capacity is variable in nine steps from .0012 mfd. to .0098 mfd.



The fixed condenser is supplied with a pair of terminals brought out through porcelain bushings on the cover. It has a capacity of .055 Mfd.

Each furnished complete with oil. The weight is approximately 45 pounds.

TYPE	TYPE NO.	MAX.	DIMENSIONS
		CAPACITY	
Variable	T-5414	.0098 Mfd.	7" x 17" x 12½"
Fixed	T-5415	.055 Mfd.	12¼" x 15½" x 15"



TYPE T-5419

High Voltage Test Transformers

An oil insulated transformer for testing insulating oils, insulation of all kinds and general laboratory use.

The transformer is mounted in a round welded steel case with a suitable steel cover. Handles are provided for easy handling. The secondary terminals are brought out through large porcelain insulators which carry an adjustable needle gap. The adjustable gap is variable by means of a rack and pinion belted to a hand wheel to permit adjustment while in operation. The secondary terminals are also provided with clips for supporting a glass oil testing cup.

The characteristics of the transformer are as follows:

Primary—100 volts, 60 cycles.

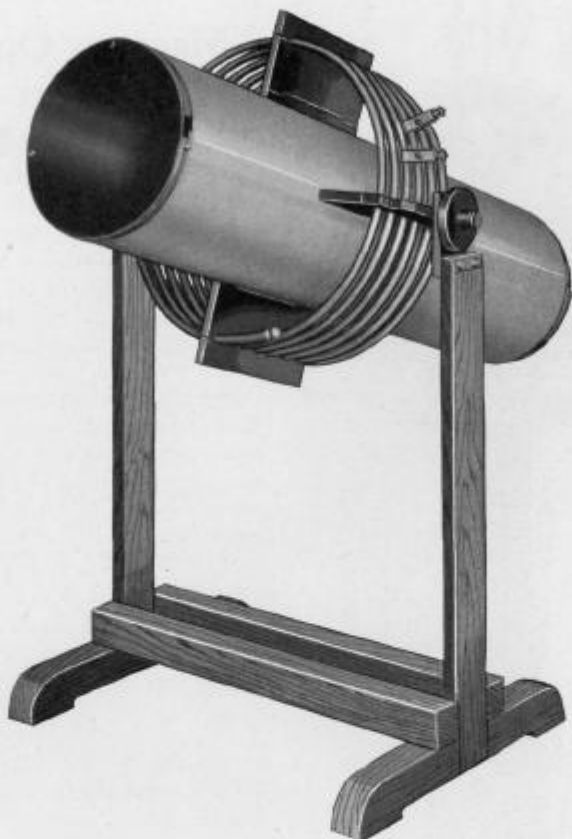
Secondary—40,000 volts—center point grounded.

Capacity—1 K.V.A.

Ratio—400 to 1.

Weight—185 lbs.

Dimensions—14" dia. x 37" high.



TYPE T-5416

Tesla Coil

A tesla coil of conventional design for demonstration purposes.

It consists of a secondary winding wound on a tube $9\frac{1}{2}$ inches in diameter and 36 inches long supported and insulated from a primary of 6 turns of heavy copper tubing. The primary is adjustably supported in a well made wooden frame.

Capable of supplying a high frequency spark 36 inches long.

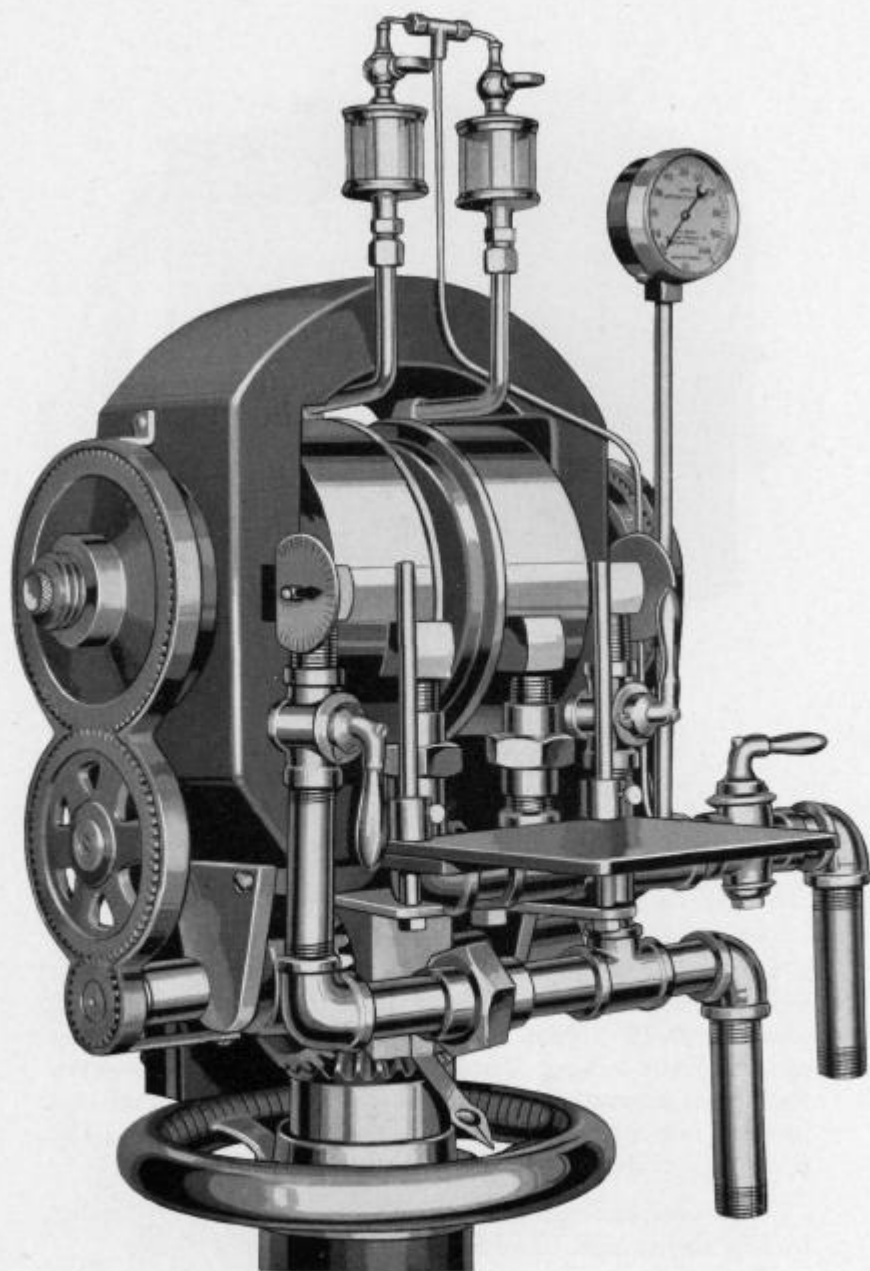


TYPE T-5417

Magneto Optics Magnet Water Cooled

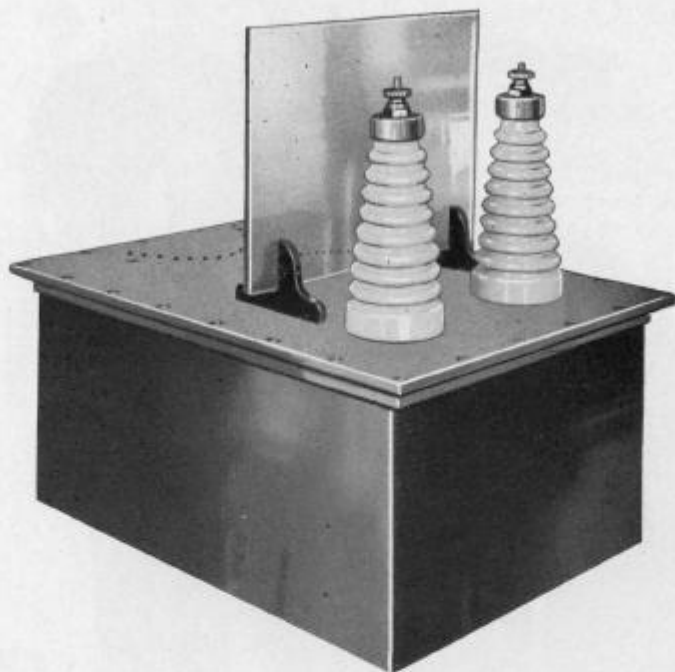
This design differs radically from magnets heretofore used for this purpose. This magnet having a double return magnet circuit. The iron return path outside the coils is of very much larger cross section than is possible with a U magnet frame of same weight. The cores in the coils are moved by means of right and left handed screws operated by the hand wheel shown below and accurately graduated for movements to $1/1000$ inch.

Each coil has an independent water supply for cooling the windings. Each intake is separately adjusted by valves. The water outlet flow is also regulated by valves and the water pressure varied thereby. The exact pressure is measured on the pressure gauge shown. Steam or air forming over the coils will readily rise into oil cups above the magnet and can be readily removed through the drain pipe. As a special safety feature to insure the proper flow of water, a vane on each water pipe indicates on a dial the amount of water flowing. If water should stop flowing an electric circuit is energized and trips the circuit breaker. Therefore, the water must be turned on and flowing before the electric circuit can be closed. An adjustable platform for supporting the optical instruments that can be raised or lowered at will is an added feature.



Removable tapered pole pieces are furnished with the magnet.

Densities of 100,000 ampere turns can be attained under normal conditions.



TYPE T-5418

Non-Inductive Resistor

A wire wound resistor of non-inductive type. The resistor is wound in units of 50,000 ohms each, each brought out to a separate terminal. Twenty steps provide a range from 50,000 ohms to 1,000,000 ohms. The units are immersed in insulating oil to facilitate cooling. The maximum current is .050 amperes. Rating—1 kilowatt for 15 minutes. The two terminals are brought out through high voltage porcelain insulators. The operator is protected by a sheet of plate glass.

The complete assembly measures $15\frac{1}{2}$ inches by $11\frac{1}{2}$ inches by $15\frac{1}{4}$ inches high. Finished in black. Weight 50 lbs.



TYPE T-2182

Variable Voltage Transformer

A laboratory transformer for giving any output voltage from 1 volt to 440 volts in 1 volt steps.

This transformer is wound for 110 or 220 volts 60 cycles on the primary. A double pole double throw switch makes possible a change to either voltage instantly. If necessary, by using the 220 volt winding, the transformer can be used on 110 volts 25 cycles.

The variation of secondary voltages is accomplished by a series of nine single pole double throw knife switches by which you can selectively add any of the various voltages.

The transformer has an average output capacity of 500 v.a. The primary is equipped with a cord and plug. The secondary terminates in a standard receptacle.

Dimensions—10" x 13½" x 8¾" high. Weight—47 lbs.



TYPE R AND RS
High Voltage Transformers

Open type transformers for general laboratory use where high voltages are required.

The type "R" Thordarson transformer is widely known throughout the electrical and radio industry. It is constructed on the double magnetic circuit principal, one magnetic circuit being adjustable through the variation of a tongue shaped laminated shunt. The secondary coil is paper section, layer wound and is protected outside by a patented aluminum static shield.

The type "R" design is furnished in three capacities, all for operation on 110 volts 60 cycles.

SECONDARY

TYPE NO.	K.V.A.	VOLTS	DIMENSIONS	WEIGHT
T-2742	$\frac{1}{2}$	10,000	10" x 5" x 11 $\frac{1}{2}$ "	38 lbs.
T-2480	$\frac{3}{4}$	10,000	10" x 5 $\frac{1}{2}$ " x 12"	40 lbs.
T-2479	1	25,000	10 $\frac{3}{4}$ " x 6" x 14 $\frac{1}{2}$ "	62 lbs.

The type "RS" is similar to the type "R" except that it is of the simple core type construction and does not have the double magnetic circuit. It also is furnished in three sizes for operation on 110 volts 60 cycles.

SECONDARY

TYPE NO.	K.V.A.	VOLTS	DIMENSIONS	WEIGHT
T-2355	$\frac{1}{4}$	8,000	5" x 4 $\frac{1}{4}$ " x 8"	15 lbs.
T-2413	$\frac{1}{2}$	10,000	7" x 5" x 10"	25 lbs.
T-2525	1	15,000	8" x 5 $\frac{1}{2}$ " x 11"	35 lbs.

Other high voltage transformers of larger capacity also available. Let us know your requirements.

Electrical Testing of Insulating Oils

In our modern field of electrical power transmission, it now appears that oil holds almost as important a part in the system as copper and iron. The art of electrical testing of insulating oils does seem, to most engineers, as comparatively new, a development of this century. It will therefore surprise them to learn that Mr. Morgan, over a hundred years before, had made a fairly thorough study on this subject which the following discourse, quoted from his lessons on electricity, will show. It is all the more remarkable when we consider that this was written before Alessandro Volta had discovered the electric current.

C. H. THORDARSON.

"No charge will pass through oils of any kind, till the conducting points are brought within what I call the luminous or breaking distance of each other.

It should therefore, be our chief object to ascertain the relation which subsists between the breaking distances and the nature and dimensions of the oils. The most puzzling anomalies for a long time infested my experiments on this subject. At length I found that every variety of result might be avoided by attending to the following circumstances:

The length of the breaking distance is often increased by the adherence of small particles of air or vapour to the points of the conducting wires.

Every distinct charge is attended, not only with a change of temperature in the oil, but with a separation of coaly matter, from one minute portion of which to another the electric fluid passes with much greater ease, than through oil when perfectly pure.

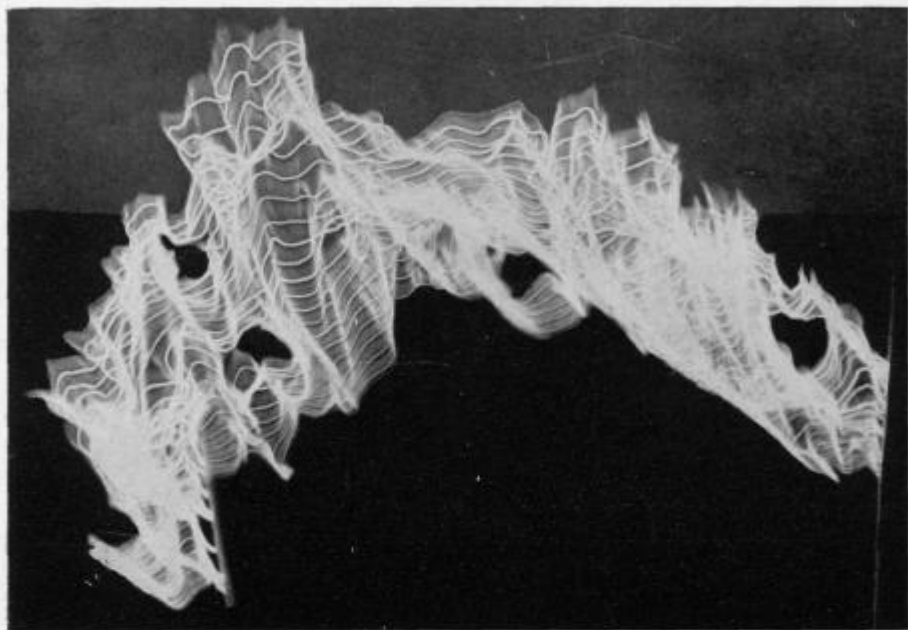
If the least moisture adheres to the surface of the vessel, it will soon mix with the oil, and will increase the breaking distance, most commonly to double, and frequently to three times its proper length.

To prevent the irregularities which arise from the preceding causes, we should always use glass tubes.

Oil should never be used twice; for even one charge produces the coaly matter. Besides, the oil should be well boiled, and care taken that its temperature is invariably the same in each distinct experiment.

The degree of resistance in oils to the passage of the electric fluid seems to have some connection with their specific gravities.

The power of oils to resist the passage of the charge varies with their temperatures. The breaking distance lengthens as the heat is increased."



An Arc 100 Inches Long

A most remarkable and unusual photograph of a million volt discharge from a 100 KVA 25 cycle Thordarson transformer made and perfected in 1904. This transformer was exhibited by Thordarson at the Louisiana Purchase Exposition at St. Louis.

Thordarson Electric Mfg. Company

500 West Huron Street

Chicago, Illinois

PRICE LIST

LABORATORY AND DEMONSTRATION APPARATUS

Type No.	Description	Page	
T-5261	Double Magnetic Circuit.....	8	\$ 34.00 ea.
T-5400	Single Magnetic Circuit.....	9	18.00 ea.
T-5401	Triple Magnetic Circuit.....	10	42.00 ea.
T-5262	A. C. Primary Coils.....	11	9.00 ea.
T-5263	D. C. Coils.....	12	12.00 ea.
T-5265	Secondary Coils.....	13	20.00 ea.
T-5402	Surge Damping Coils.....	14	2.50 ea.
T-5403	Pole Piece.....	15	7.00 pr.
T-5404	Rotating Discs.....	16	10.00 ea.
T-5405	Ball and Stand.....	16	13.75 set
T-5406	Lamp and Coil.....	17	5.50 set
T-5407	Discs.....	17	4.00 set
T-5408	Copper Ring.....	18	1.50 ea.
T-5409	D. C. Exploring Coil.....	18	5.00 ea.
T-5410	Cords and Connectors.....	19	3.00 pr.
T-5411	D. P. D. T. Switch.....	19	3.50 ea.
T-5412	Sphere Gap Testing Frame.....	28	90.00 set
T-5264	Spot Welding Attachment.....	30	60.00 ea.
T-5413	Spark Gap.....	32	40.00 ea.
T-4090	A. C. Regulator.....	34	50.00 ea.
T-2226	3" Induction Coil.....	35	50.00 ea.
T-2315	6" Induction Coil.....	35	85.00 ea.
T-5414	Variable Oil Condenser.....	37	~~40.00 ea.~~ 40
T-5415	Fixed Oil Condenser.....	37	~~60.00 ea.~~ 43
T-5419	High Voltage Test Transformer.....	38	200.00 ea.
T-5416	Tesla Coil.....	39	On request
T-5417	Magneto Optics Magnet.....	40	On request
T-5418	Resistor.....	42	75.00 ea.
T-2182	Variable Voltage Transformer.....	43	60.00 ea.
T-2742	High Voltage Transformer.....	44	22.00 ea.
T-2480	High Voltage Transformer.....	44	28.00 ea.
T-2479	High Voltage Transformer.....	44	40.00 ea.
T-2355	High Voltage Transformer.....	44	10.00 ea.
T-2413	High Voltage Transformer.....	44	20.00 ea.
T-2525	High Voltage Transformer.....	44	30.00 ea.

We invite inquiries for special apparatus.

Prices F. O. B. Chicago.

Terms—2% 10 days, 30 days net.

Prices subject to change without notice.