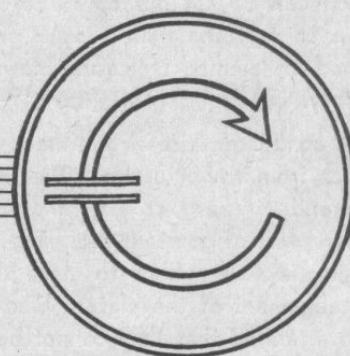
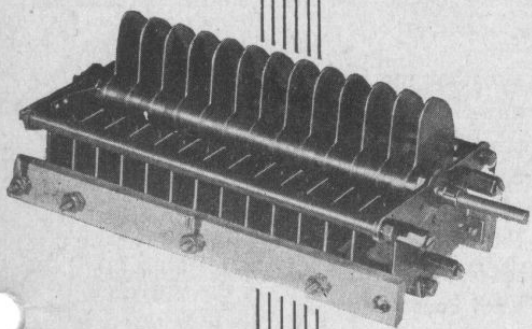


CARDWELL

CONDENSERS



1935-6

UNCLE DAVE'S RADIO SHACK
386 BROADWAY, ALBANY, N. Y.
Distributor of FORT ORANGE RADIO DIST. CORP.

THE ALLEN D. CARDWELL MANUFACTURING CORPORATION
81 PROSPECT STREET
BROOKLYN, NEW YORK

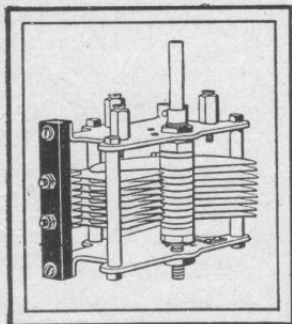


CARDWELL

CONDENSERS



THE ALLEN D. CARDWELL MANUFACTURING CORPORATION was the first to adopt the now standard method of condenser construction: the use of metal end-plates and grounded rotors, and the supporting of the stator by means of small insulation strips instead of bushings. The Cardwell Company produced the first "low loss" condenser over a year-and-a-half before the efficiencies which the Cardwell design afforded were sufficiently understood by others



to suggest their following the same general design. By this original construction, which was characterized by engineers as "low loss" to distinguish the Cardwell from ordinary varieties, the Cardwell Company was able to offer the public a laboratory-type condenser at a low price.

The ideals of good condenser design are now well understood by the advanced radio experimenters, but a brief review may not be amiss in pointing out the more refined details of construction. A condenser is a piece of machinery as well as a finely balanced electrical instrument. It must be able to withstand rough usage, retain its rating under varied temperature conditions, give a permanent alignment of plates, have a proper bearing which will afford smooth, firm action, etc. Any condenser which can be set out of shape by pressure of panel screws so that the plates touch or which will become loosened or jammed by casual blows will never prove satisfactory.

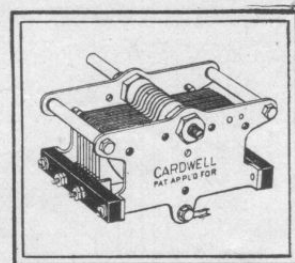
The Cardwell condenser is so strong mechanically that it will not suffer from rough usage. The bearings are accurately set and adjusted so that they will remain serviceable after years of constant use. The frame is so built that it takes a severe blow to make the slightest change in the alignment of the plates. The spacing of the plates is so arranged that they cannot become wide or narrow on one side, due to the heat of the vacuum tubes.

Since Cardwell inaugurated the present well-known principle of metal end-plates and a minimum of dielectric as a support for the stator, this construction has become almost standard. The plates of the stator, it will be noticed, are first pressed into slots in the brass blocks used as spacers and support and then the whole assembly is struck a heavy blow by a huge press in such a manner

that the material of the stator plates and the blocks are driven into one compact mass. These blocks are held by screws which run through the insulating strips which are mounted on end-plates. The distance from the end-plate screw to the stator screw is ample to maintain a high resistance between these points. The area of contact at each supporting point has been reduced to a minimum. The screw posts from the stator do not touch the insulation except where the ends are locked by a small circular seat. The area of this on one side and the washer on the other end, when added together, give the smallest possible surface contact with the insulation. This means that very little of the insulation is in the condenser circuit and the hysteresis losses are accordingly low.

It will be noted also that the insulation is placed out at the edge of the end-plates, so that it is in a relatively weak field between the end-plates and the stator plates at the points where the insulation is supported and is in an even weaker field where the stator strip is held to the insulation. Thus the insulation is held almost entirely outside of the electrostatic field where induced capacity effects will not cause losses.

The arrangement of the insulation in the weakest part of the electrostatic field and the restriction of the surface area used in contact between the insulation and the stator screws are some of the most important elements of the Cardwell design. The blocks supporting the stator, being continuous and extending beyond the points of support, shield the insulation from all stray field. In this respect no type of construction has been found since, which can secure lower losses or better engineering than in the Cardwell.



Thus far we have dealt only with the broader consideration of good condenser design. In the succeeding paragraphs we point out a number of specific Cardwell features which have no small importance in the satisfactory operation of a receiver or transmitter.

The end bearing consists of a steel ball bearing (see Fig. 3:G) which is set in a cup at the end of the rotor shaft (F) and also set in a cup on the end adjusting-screw (I) which fixes the center of the shaft in perfect alignment and affords a smooth turning action. The shaft is of

case-hardened steel and the end adjusting-screw is also of case-hardened steel. The bearing is practically immune from wear, as the case-hardened ball bearing revolves in a thin film of oil and is constantly keeping a fixed center and uniform pressure.

The end play of the shaft is adjusted at one end (see Fig. 4) by a broad hexagonal-headed brass bushing locked to end-plate (D) by lock nut (E). A steel spacer (F) rests against the hexagonal bushing (E) and thus two dissimilar metals afford a fine bearing which is not subject to wear or play.

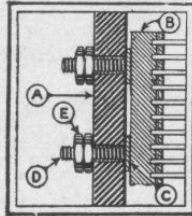


Figure 1.
Stator Support

The shaft bushing (Fig. 4:E) has a projecting split collar (B) which gives a firm even pressure against the shaft (A), thereby insuring a good contact from rotor to shaft, but also avoiding any tendency of the rotor to turn due to its weight.

The condenser employs a special type of friction contact at the end bearing (see Fig. 5) which fits snug against the under side of the turned nut (see Fig. 3:D) and presents a broad surface for positive contact (see Fig. 5:C). This special friction contact is not entirely needed, but doubly assures absolutely noiseless operation and is only added as a special precaution.

The stator plates (see Fig. 1) are swedged into grooves in brass blocks (B) by a special assembly process which insures unvarying pressure and avoids any risk of conductivity losses. The grooves in the blocks are sufficiently deep and long to afford a rigid alignment of the stator plates and also act to prevent any changes in the clearances at their centers.

The rotor plates (see Fig. 6) are spaced by micrometer brass spacers (G), which are very accurately finished. The surfaces are broad and afford ample area to maintain the rotor plates flat and in perfect parallel with the stator plates. The pressure on the rotor plates and spacers is very great, one end (A) being locked against the steel collar spacer (B), which rides on the shaft (A-F), and the other end being washer-locked by a thread on the shaft, and a hexagonal lock nut (E), which is tightened by a heavy wrench. As the diameter across the washers is nine-sixteenths of an inch, it is practically impossible to get any of the rotor plates to turn on the shaft.

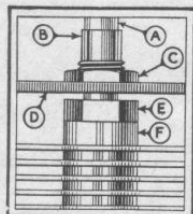


Figure 4.
Panel Bearing

The dimensions of all rods, end-plates, shaft and supporting elements are amply designed to insure mechanical strength. By means of extra-heavy construction and

the use of selected raw materials, the condenser has almost unbreakable characteristics.

Cardwell condensers are insulated with either an especially formulated rubber compound or mycalex. This compound is used for receiving or low power transmission. Mycalex is used for higher power because its insulating qualities and rigidity insure the lowest electrical loss and the strongest mechanical construction of any condenser ever offered to the radio industry.

Close inspection of the construction of a Cardwell condenser reveals the vital points of superiority which, for more than fourteen years, have made Cardwell the choice of leading radio engineers, experimenters, and amateurs. With the introduction of ultra high frequencies, condenser losses became even a more serious problem. The basic patented design of Cardwell condensers proved the earlier Cardwell engineering principles more forcibly than ever before.

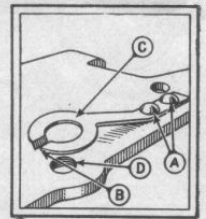


Figure 5.
Auxiliary Contact

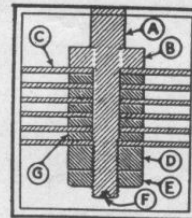


Figure 6.
Rotor Elements

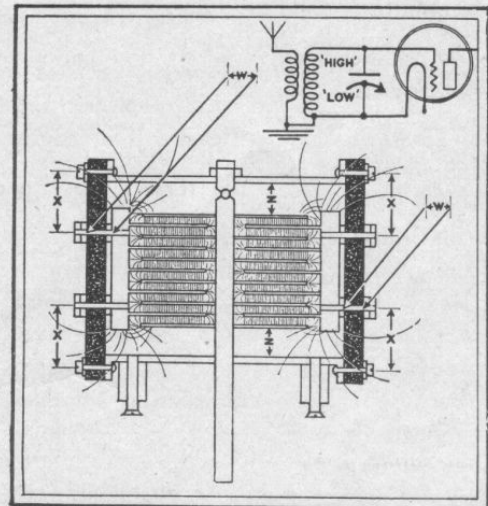
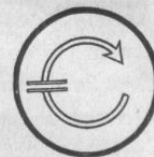


Figure 2. Theoretical Sketch (cross section), showing how losses are held low. Note that the shaft and rotor plates are one side of circuit and are grounded to end plates. The stator plates are supported by screws (refer to Fig. 1), which hold the blocks (B) into which the plates are swedged. These screws give no real contact to the insulation, but the inner seating washers (C) and the outer lock nuts (E) are relatively small in surface, resting against the insulation (A). In Figure 2, the distances (W) are practically air spaced from the insulation. This reduces the amount of surface of the high (stator) side to the insulation, thereby reducing hysteresis losses to a minimum. The intensity of the field is indicated by the fine lines between the plates and the stray field by the fine curved lines. Note that the blocks holding the stator plates act as shields to keep the stray fields out of the insulation. Also note that the distance (X) is relatively large and affords an extremely high resistance path to the currents which might tend to leak across the insulation. The distances (Z) permit a low minimum capacity as does also the plate spacing between rotor-shaft elements and stator plate edges.

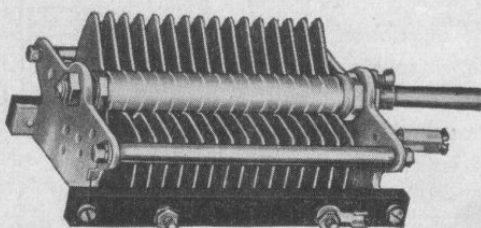


RECEIVING CONDENSERS

Straight Line Capacity Type

Also for use in lower powered transmitters

The name "Midway Featherweight" was given to this newest condenser design developed by the Cardwell Company. The "Midway" is a small and compact variable air condenser incorporating all of the basic and advanced engineering features of the Cardwell patents. It is designed for use in receivers, low power transmitters and oscillator amplifiers. Because the Midway is light in weight and requires a panel space of only 3" x 2 1/8" it is adapted to portable receivers; and transmitters of 25 watts C.W. or lower. It is meeting with a wide degree of uses in aeroplane transmitters and receivers of smaller dimensions. Wide surfaces at joining points in the frame insure rigidity, while cap screws and studs securely held by lockwashers and nuts afford permanent, steady tension at all important points. Only deliberate tampering will loosen this assembly. There are no swedged rivet or eyelet heads to become slack or inert because of long continued strain due to vi-



bration or shocks or because of temperature changes causing expansions or contraction of the insulation. Ruggedness and strength have not been sacrificed to any expedient making for cheapness of manufacture. Aluminum is used throughout with the exception of the cadmium plated steel shaft running in brass bearings and the bronze to brass wiping contact.

Midway Condenser GENERAL SPECIFICATIONS

Apply to every Midway condenser, receiving, transmitting, neutralizing, etc.

Overall mounting space 3x2 1/8 inches

Shaft diameter 1/4 inch

Shaft length (from back of panel) 1 inch

Material of insulation—Radion (Mycalex extra)

Material of plates —Aluminum

Material of frame —Aluminum

General construction, quality and design—exactly as identified with other CARDWELL Condensers.

STOCK SIZES MIDWAY RECEIVING CONDENSERS

Air Gap Between Plates .031"

For Breakdown Voltages Consult Chart on Page 12

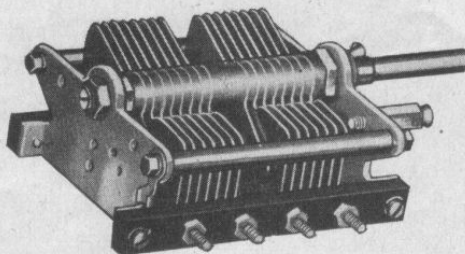
Type	Old Type Number	Max. Cap.	Min. Cap.	Plate Edges	No. of Plates	Weight	Depth Behind Panel	List Price
MR- 25-BS	401-B	25	7	Plain	3	4 oz.	2 9/16"	\$2.30
MR- 50-BS	402-B	50	8	"	5	4 1/4 "	"	2.40
MR- 70-BS	403-B	70	9	"	7	4 1/2 "	"	2.55
MR-105-BS	404-B	105	10	"	11	5 "	"	2.65
MR-150-BS	405-B	150	11	"	15	5 1/2 "	"	2.75
MR-260-BS	406-B	260	13	"	25	6 "	3 9/16"	2.80
MR-365-BS	407-B	365	14	"	35	7 "	"	3.30

Please use new type numbers when ordering

MIDWAY TRANSMITTING CONDENSERS

Straight Line Capacity Type

The Midway series of transmitting condensers has received general acceptance in the Amateur, Experimental and Commercial fields. The frame design permits mounting the condenser in a minimum of space yet provides all of the low loss features of the Cardwell method of construction which are controlled by basic patents.



The air gap or space between rotor and stator plates is .070 inches and in one type MG-35-GS, .171 inches. The plates are rounded and polished overall, thus assuring higher peak flashover voltages with a minimum of corona losses.

This series is especially suitable for use in C.W. trans-

mitters up to 100 watts power or phone transmitters of 30 watts carrier with 100% modulation. The insulation between rotor and stator plates is a specially developed rubber compound which has a rated resistance to surface leakage well above the average insulation generally used in condenser construction. It is impervious to moisture and lasts a lifetime.

Many condensers in this series will be found suitable as neutralizing condensers for various types of tubes. The type MG-35-GS, having a .171 air gap and mycalex insulation between stator and rotor, is especially recommended for neutralizing 50 watt modulated stages.

MIDWAY DOUBLE CONDENSERS

The terms double or split stator are often specified in circuit diagrams. This leads to the belief that there is a difference between a double condenser and a split stator condenser. Cardwell double condensers are actually two single condensers built into the same frame having a common rotor. Condensers designed in this manner are often referred to as split stators, thus the use of two terms designating the same type of condenser. When a circuit diagram is published, the originator usually refers to a double condenser or a split stator condenser as one having an equal maximum capacity in each section.

Therefore Cardwell double condensers are listed in the following manner. As an example, Cardwell type MR-25-BD has a maximum capacity of 25MMF in each section or a total of 50 MMF when the stators are connected in parallel and a total of 12½ MMF when the stators are connected in series.

The general Midway specifications also apply to the double Midway types. It is important to note that the voltage break-down of a double condenser connected in series is from 1.6 to 2.1 times that of a single unit air gap indicated in the voltage break-down chart on page 12.

STOCK SIZES MIDWAY TRANSMITTING CONDENSERS

For Breakdown Voltages Consult Chart on Page 12

Type	Old Type Number	Max. Cap.	Min. Cap.	Plate Edges	No. Plates	Air Gap	Plate Thickness	Depth Behind Panel	Weight	List Price
MT- 20-GS	408-B	20	6	Rounded	5	.070	.025	2 9/16"	4 oz.	\$2.85
MT- 35-GS	409-B	35	9	"	7	"	"	"	4 ½ "	3.10
MT- 50-GS	410-B	50	11	"	11	"	"	"	5 "	3.50
MT- 70-GS	411-B	70	13	"	15	"	"	3 9/16"	5 ½ "	3.95
MT-100-GS	412-B	100	15	"	21	"	"	"	6 "	4.40
MT-150-GS	413-B	150	18	"	31	"	"	4 1/2"	7 "	5.50
MG- 35-GS*	415-B	35	11	"	15	.171	.040	"	7 "	6.00

STOCK SIZES MIDWAY DOUBLE CONDENSERS

Type	Old Type Number	Max. Cap. Each Section	Min. Cap. Each Section	Plate Edges	Number of Plates Per Sec.	Air Gap	Plate Thickness	Depth Behind Panel	List Price
MR- 25-BD	401-BD	25	7	Plain	3	.031	.025	2 9/16"	\$3.95
MR- 50-BD	402-BD	50	8	"	5	"	"	3 9/16"	4.20
MR- 70-BD	403-BD	70	9	"	7	"	"	"	4.40
MR-100-BD	404-BD	100	10	"	11	"	"	"	4.60
MR-150-BD	405-BD	150	11	"	15	"	"	"	4.80
MR-260-BD	406-BD	260	13	"	25	"	"	4 1/2"	5.00
MT- 20-GD	408-BD	20	6	Rounded	5	.070	"	2 9/16"	5.05
MT- 35-GD	409-BD	35	9	"	7	"	"	3 9/16"	5.50
MT- 50-GD	410-BD	50	11	"	11	"	"	"	5.85
MT- 70-GD	411-BD	70	13	"	15	"	"	4 1/2"	6.50

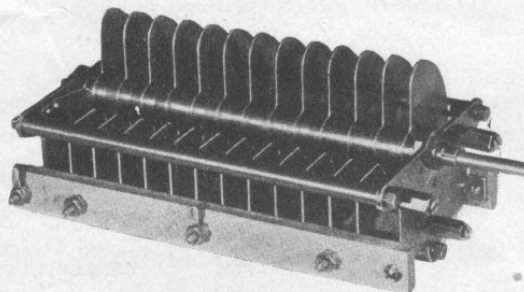
*Mycalex Standard

Please use new type numbers when ordering

STANDARD TRANSMITTING CONDENSERS

This series of standard transmitting condensers incorporates every new and advanced feature in condenser design and construction developed in the Cardwell laboratories during the past fourteen years of specialization in air condenser development and manufacture. The frames and connecting rods are made of highly nicked brass. The plates in the stator and rotor are of heavy aluminum with rounded edges and are highly polished overall. Mycalex insulation is used in the types designed for higher voltages. The rotor bearing is of the ball and thrust type. The rotor contact is of phosphor bronze. All bushings are nickel plated brass. A steel shaft supports the rotor plates and spacers.

The Cardwell standard condensers are rightfully classed as radio instruments rather than a group of plates held into a frame. Only experienced and highly skilled mechanics are employed in producing these finely balanced and accurate tuning devices. Each and every standard condenser is individually aligned, checked and tested by skilled experts in this art. With the exception of standard studs, nuts, etc., Cardwell standard condensers are hand made precision instruments. They are accurate in electrical rating and extremely rugged to withstand all kinds of abuse and give dependable service for indefinite periods of time.



There are two frame sizes housing the standard series. These are designated in the table below by the first letter in the type number. The "X" frame measure $2\frac{3}{8}$ " by 4" and the "T" frame $3\frac{3}{4}$ " by 6". The "T" frame condenser is designed for extra heavy duty, having thicker plates and generally greater air spacing between stator and rotor plates. As an indication of the

adaptability of the standard series the following condensers have been conservatively selected for general use.

Type XP-330-KS or equivalent, for use in C.W. transmitters of 150 watts or phone transmitters of 50 watts carrier with 100% modulation.

Type XE-240-KS or equivalent, for use in C.W. transmitters of 200 watts or phone transmitters of 75 watts carrier with 100% modulation.

Type XG-110-KS or equivalent, for use in C.W. transmitters of 450 watts or phone transmitters of 150 watts carrier with 100% modulation.

Type XC-100-XS or equivalent, for use in C.W. transmitters of 750 watts or phone transmitters of 250 watts carrier with 100% modulation.

Type TL-200-US or equivalent, for use in C.W. transmitters of 1 K.W. or phone transmitters of 450 watts carrier with 100% modulation.

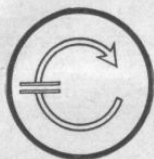
If the condenser to suit your requirements does not appear on this page, our special condenser department will build a condenser to fit your individual need. Write to this department about your special condenser requirements.

STOCK SIZES STANDARD TRANSMITTING CONDENSERS
For Breakdown Voltages Consult Chart on Page 12

Type	Old Type Numbers	Max. Cap.	Min. Cap.	Plate Edges	No. of Plates	Air Gap	Plate Thickness	Depth Behind Panel	List Price
XT-220-PS	164-B	220	23	Plain	21	.070	.025	4"	\$ 4.00
XT-440-PS	147-B	440	42	"	43	"	"	5 3/4"	7.00
XP- 90-KS*	New	90	14	Rounded	11	.084	.040	3"	4.50
XP-165-KS*	"	165	20	"	19	"	"	4"	6.50
XP-290-KS*	"	290	32	"	33	"	"	5 3/4"	9.50
XP-330-KS	T-199	330	41	"	37	"	"	6 1/2"	10.00
XE-240-KS	520-B	240	32	"	33	.100	"	6 1/2"	10.00
XG- 25-KS	511-B	25	10	"	5	.171	"	3"	3.00
XG- 50-KS	513-B	50	17	"	11	"	"	4"	6.00
XG-110-KS	T-183	110	31	"	23	"	"	6 1/2"	9.00
XK- 55-KS*	515-B	55	20	"	15	.230	"	5 3/4"	10.00
XC- 18-XS*	New	18	6	"	5	.200	"	2 1/2"	5.50
XC- 40-XS*	"	40	13	"	11	"	"	4"	7.50
XC- 65-XS*	"	65	18	"	17	"	"	5 3/4"	9.50
XC-100-XS*	"	100	26	"	25	"	"	7 3/8"	11.50
TJ-150-US*	3280	150	28	"	15	.168	.050	5 13/16"	23.00
TJ-315-US*	3279	315	38	"	31	"	"	9 9/32"	32.00
TC-150-US*	New	160	38	"	19	.200	"	7 1/4"	24.00
TC-200-US*	"	200	40	"	23	"	"	8 1/4"	28.00
TC-300-US*	"	300	42	"	35	"	"	11 1/4"	32.00
TL- 50-US*	3278	50	18	"	7	.294	"	4 13/16"	20.00
TL- 80-US*	3277	80	29	"	13	"	"	6 7/8"	22.00
TL-160-US*	3276	160	40	"	25	"	"	11"	30.00
TL-200-US*	New	200	46	"	31	"	"	13 1/8"	33.00

*Mycalex Standard

Please use new type numbers when ordering



STANDARD DOUBLE TRANSMITTING CONDENSERS



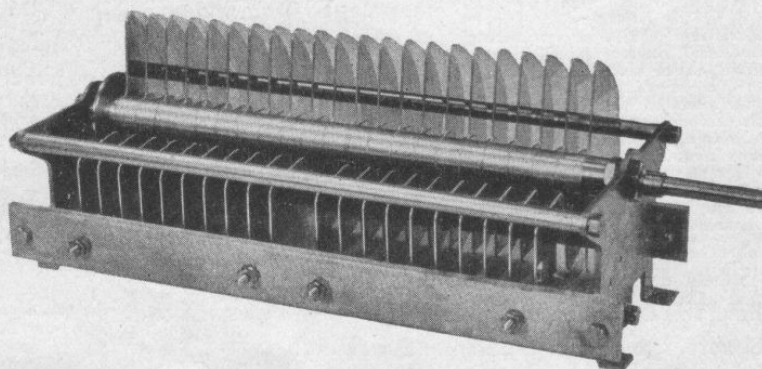
The construction and design of the standard double condensers listed below, may be found by referring to the data on standard, single condensers on the preceding page.

The details of construction in a single and a double standard condenser are identical. A single or double type is designated by the letter "S" for single and "D" for double in the type number.

In selecting the maximum capacity for each section to be built into a double condenser, the Cardwell engineers paid particular attention to the uses for which these double condensers are intended. The higher maximum capacities were designed as high as practicable in each instance to permit smaller inductances in tank circuits operating at 2000 K.C. Physical dimensions were not allowed to exceed accepted measurements of the average transmitter panel. Reference to the voltage breakdown chart on page 12 will indicate that these double condensers will have between 1.6 and 2.1 times the flashover rating of a single condenser in the standard series.

Heavy construction, liberal plate spacing, mycalex insulation, smooth and accurate bearings, and perfect contact all combine to make these condensers the overwhelming choice for amateur and commercial transmitters.

The rotor of the condenser is at ground potential, with a stator connected to each side of the coil in the tank circuit. Hand capacity effects are at absolute minimum thus tuning amplifiers to full resonance at higher frequencies is accurate and dependable. These condensers may be mounted on a metal panel without insulating one



from the other. There is no danger of R.F. burns through the condenser handle.

The Cardwell engineering staff made no compromise when they developed the standard condenser for high power requirements. By compromise we mean using a smaller frame and extending it beyond its mechanical limit in order to obtain higher capacities and greater air gaps. The frames built into the TL-200-US or the TL-80-UD or other equivalent condensers with these designating letters, are typical examples of the high power units with the rugged frames insulated with over-size mycalex bars and generally over-size both mechanically and electrically because of the power such condensers must handle to be effective and efficient.

The table below lists the maximum capacity per section. If the stators are connected in series the resultant capacity will be approximately one half of the listed maximum. If connected in parallel the resultant capacity will be approximately double that of the capacity listed.

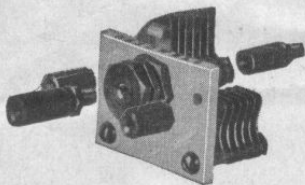
STOCK SIZES STANDARD DOUBLE CONDENSERS
For Breakdown Voltages Consult Chart on Page 12

Type	Old Type Numbers	Max. Cap. Each Sec.	Min. Cap. Each Sec.	Plate Edges	No. of Pl. Per Sec.	Air Gap	Plate Thickness	Depth Behind Panel	List Price
XR-500-PD	156-B	500	19	Plain	21	.030	.025	4"	\$ 6.00
XT- 80-PD	197-B	80	14	"	9	.070	"	4"	5.00
XT-210-PD	157-B	210	18	"	21	"	"	5 3/4"	8.00
XP-325-KD	DT-199	325	41	Rounded	37	.084	.040	11 1/4"	22.00
XE-240-KD*	521-BD	240	32	"	33	.100	"	11 1/4"	21.00
XG- 50-KD	512-BD	50	16	"	11	.171	"	6 1/2"	10.00
XG-110-KD	DT-183	110	31	"	23	"	"	11 1/4"	18.00
TJ-200-UD*	3474	200	30	"	21	.168	.050	12"	36.00
XC- 40-XD*	New	40	13	"	11	.200	.040	7 3/8"	13.00
XC- 75-XD*	"	75	20	"	19	"	"	11 1/4"	17.00
TC-160-UD*	"	160	38	"	19	"	.050	12 1/4"	34.00
TC-200-UD*	"	200	40	"	23	"	"	14 1/4"	38.00
TC-250-UD*	"	250	40	"	29	"	"	17 1/4"	42.00

*Mycalex Standard

Please use new type numbers when ordering

CARDWELL TRIM-AIR MIDGET CONDENSERS



"Trim-Air" Midget receiving condenser showing possible combinations for various uses as described in text. Note tapped rotor shaft with screwdriver slot and rotor locking nut for permanent adjustment. If used for knob control, the extension shaft is screwed into the tapped hole in rotor shaft. Mounting Brackets can be supplied (extra). See "Accessories."

The Cardwell TRIM-AIR series of condensers was designed for use wherever high quality midget condensers are required. While they depart from the basic Cardwell design, the losses are kept at minimum by using a solid piece of isolantite insulation as the frame upon which the plates are mounted. With the exception of the type ZU-140-

AS, the plates are mounted on a single block of isolantite. This exception has a block of isolantite on each end to obtain maximum rigidity and stability.

The main rotor shaft terminates at the outside end of the bearing-bushing. The end of the shaft is slotted (for screwdriver adjustment) and has a threaded hole for a shaft extension so that by screwing the shaft extension (provided) into the end of the shaft, a knob may be used for varying the position of the rotor.

The bearing-bushing is split in such a way that by means of the taper threaded lock nut, provided for this purpose, the rotor shaft may be locked in any desired position, after making a final adjustment.

Mounting posts can be supplied for use where it is desired to mount the condenser without the shaft extension. This permits adjustment and locking thru a hole in the panel with no condenser extensions thru the panel itself. This arrangement is particularly desirable if the condenser is to be mounted within a shield with a coil, as for air dielectric condenser tuned I.F. transformers. If so used, the condensers will mount within a shield as small as 2" in diameter with approximately 1/4" clearance for all metallic parts. In this case, the rotor may be adjusted by means of the screwdriver slot, and permanently locked from the outside, with a socket wrench. If used in this manner, no part of the condenser need project beyond the frame or shield, and both sides of the condenser will be insulated from ground.

If it is desired to gang two or more condensers for sub-panel or shelf mounting, use an extra extension shaft and flexible coupling.

TRIM-AIR shelf mounting brackets can be used for securing this assembly to a sub-panel or shelf. These condensers are not designed for single hole mounting when ganged.

The CARDWELL TRIM-AIR may be mounted in any of the following ways:—

Panel mounted by single nut, and knob-controlled by shaft extension.—Panel mounted by single nut (without shaft extension), screwdriver-adjusted, and locked.—Panel mounted by means of mounting posts, keeping screwdriver adjustment slot and lock nut behind panel.—Shelf mounted by means of

bracket, either knob controlled or permanently adjusted and locked.—Mounted with a coil in a can or shield as small as 2" in diameter.

NOTE: When mounted in any other manner than by single hole method (as by means of mounting posts or brackets) both sides of the condenser will be completely insulated from the panel, chassis or shield.

Due to the unique shaft assembly it is possible to so mount the Trim-air that it can be used with a conventional vernier dial.

The Trim-Air has many additional uses as follows:

As air dielectric trimmers for ganged units.—For air dielectric condenser tuned I.F. transformers.—As air dielectric padding condensers.—For tuning high frequency receivers and tuning and neutralizing low powered, high frequency transmitters.

Cardwell Trim-Air Midget Condensers

Type	Old Type Numbers	Max. Cap.	Min. Cap.	Plate Edges	No. of Plates	Air Gap	Depth Behind Panel	List Price
ZR- 15-AS	RT- 15	15	1.5	Plain	5	.031	15/16"	\$1.25
ZR- 25-AS	RT- 25	25	2.0	"	7	"	1 1/32"	1.40
ZR- 35-AS	RT- 35	35	2.5	"	11	"	1 5/16"	1.50
ZR- 50-AS	RT- 50	50	2.8	"	13	"	"	1.60
ZU- 75-AS	RT- 75	75	2.7	"	15	.020	"	1.70
ZU-100-AS	RT-100	100	2.9	"	19	"	1 13/32"	1.75
ZU-140-AS	RT-140	140	4.5	"	27	"	1 7/8"	3.15
ZT- 30-AS	XT- 30	30	2.0	"	17	.070	2 1/8"	1.85

Please use new type numbers when ordering

A new TRIM-AIR four purpose condenser is designed for use in ultra high frequency communication. It is a three plate; two solid plate rotor and one solid plate stator or two solid plate rotor and one split plate stator condenser.

It may be used in any of the following ways:—

- A 3-plate condenser with a 2-segment stator.
- A 2-plate condenser with a 2-segment stator.
- A 3-plate condenser with solid single stator.
- A 2-plate condenser with solid single stator.

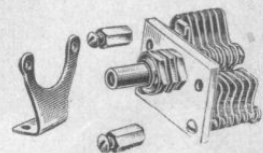
Specifications:—Type ZV-5-TS.

Air gap—.061; Plate thickness—.040; Price \$1.25 list.

Max. Cap.—5; Max. Cap. Split—1.2; Min. Cap.—1.8;

Min. Cap. Split—.4.

CARDWELL TRIM-AIR condensers, as supplied, have a detachable extension shaft, rotor-locking nut, and panel mounting nuts. The detachable shaft may be removed by holding the shaft in a vise or other clamp and backing off setting nut with a 7/32" flat wrench or pointed nose pliers. The shaft will then unscrew. The main rotor shaft will be found to project 1/16" beyond the front of the rotor shaft bushing and may be adjusted by means of the screwdriver slot provided.

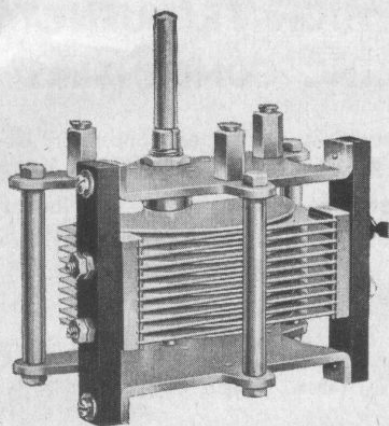


Accessories may be purchased separately, as follows:

MOUNTING BRACKET, with two screws and nuts....\$.10 list

EXTRA EXTENSION SHAFT (used for ganging) plus setting nut07 list

MOUNTING POSTS (one pair required per condenser, with screws and locking washers)10 pair



CARDWELL STANDARD RECEIVING CONDENSERS

Also suitable for low power transmitters using '10 type tubes

The Standard Cardwell condenser has the basic features and patented design so original with all Cardwell products. The frame housing this series is larger and heavier than the popular Midway series. The plates being larger permit much higher capacities than can be built into the Midway frame. Some users prefer to class this series as low power transmitting condensers due to the exceptionally rugged design and electrical stability of the unit. It is recommended for use in transmitters of 25 watts C.W. or lower.

STOCK SIZES STANDARD RECEIVING CONDENSERS

Air Gap Between Plates .030"

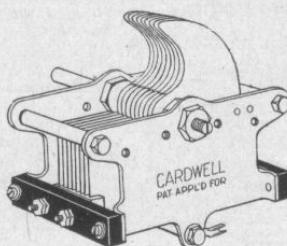
For Breakdown Voltages Consult Chart on Page 12

Type	Old Type Number	Max. Cap.	Min. Cap.	Plate Edges	No. of Plates	Weight	Depth Behind Panel	List Price
XR- 50-PS	159-B	50	11	Plain	3	11 oz.	2 3/8"	\$3.00
XR- 100-PS	188-B	100	12	"	5	"	"	3.00
XR- 150-PS	154-B	150	13	"	7	"	"	3.00
XR- 250-PS	141-B	250	15	"	11	13 "	"	3.00
XR- 375-PS	152-B	375	18	"	17	14 "	2 7/8"	3.50
XR- 500-PS	123-B	500	21	"	21	15 "	"	4.00
XR-1000-PS	137-B	1000	31	"	41	21 "	4"	5.00

Please use new type numbers when ordering

CARDWELL SEMI-SLW CONDENSERS

The semi-straight line wavelength condenser with a tuning curve beginning with straight frequency and changing to straight capacity is ideal for use in tuned radio frequency circuits.



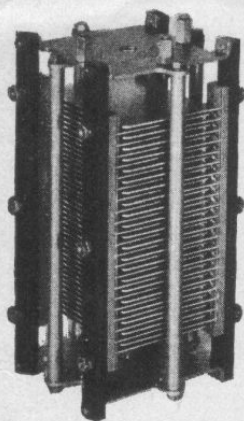
This series is built in both the standard frame and the featherweight Midway frame. In the table, shown below, the first letter in the type number indicates the frame "M" for Midway and "X" for Standard.

CARDWELL SEMI-SLW CONDENSERS

Type	Old Type Number	Max. Cap.	Min. Cap.	Air Gap	No. of Plates	Weight	Depth Behind Panel	List Price
XR- 50-HS	191-C	50	10	.030	3	10 oz.	2 3/8"	\$ 3.00
XR- 90-HS	167-C	90	11	"	5	11 "	"	3.00
XR- 140-HS	168-C	140	13	"	7	11 "	"	3.00
XR- 250-HS	170-C	250	15	"	13	13 "	2 7/8"	3.00
XR- 350-HS	171-C	350	16	"	17	13 "	"	3.50
XR- 500-HS	173-C	500	18	"	25	18 "	4"	4.50
XR-1000-HS	176-C	1000	38	"	71	24 "	5 7/8"	10.00
MR- 25-CS	401-C	25	7	"	3	4 "	2 9/16"	2.30
MR- 45-CS	402-C	45	8	"	5	4 1/4 "	"	2.40
MR- 65-CS	403-C	65	9	"	7	4 1/2 "	"	2.55
MR- 100-CS	404-C	100	10	"	11	5 "	"	2.65
MR- 140-CS	405-C	140	11	"	15	5 1/2 "	"	2.75
MR- 240-CS	406-C	240	12	"	25	6 "	3 9/16"	2.80
MR- 345-CS	407-C	345	14	"	35	7 "	"	3.30

Please use new type numbers when ordering

CARDWELL FIXED CONDENSERS



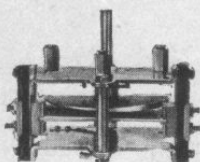
The fixed condensers in this series follow the basic Cardwell design with the exception that the plates are square. Thickness of plates in this table is .040. Plate edges and corners are rounded and polished. These condensers are shipped with three extension posts for panel mounting unless mounting brackets are specified. Special capacities will be furnished on special order.

Stock Sizes STANDARD Fixed Condensers
For Breakdown Voltages Consult Chart on Page 12

Type	Old Type No.	Cap. mmfds	Air Gap	No. of Pl.	Depth Behind Panel	List Price
FT- 250-YS	501	250	.070	12	2 1/2"	\$4.50
FT- 420-YS	502	420	.070	20	3 3/4"	7.00
FT-1000-YS	503	1000	.070	48	7 1/2"	10.00
FS- 220-YS	504	220	.1535	22	5 1/2"	15.00

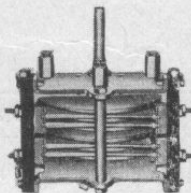
Please use new type numbers when ordering

CARDWELL TAPER PLATE CONDENSERS



The taper plate Cardwell condenser introduced the ideal tuning curve midway between straight wavelength and straight frequency. This is the logical answer to a demand for a

condenser which gives ample separation on all wavelengths. In this condenser, a stiffness is obtained which has been heretofore unequalled. Calibration of a set using these condensers will remain the same for all time. The condenser is particularly adapted for short wave receivers due to the extreme rigidity of the plates which eliminates all tendency toward so-called "wobblulation".



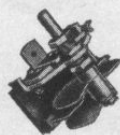
CARDWELL TAPER PLATE CONDENSERS

Type	Old Type No.	Max. Cap.	Min. Cap.	No. of Pl.	D'pth Beh'd Panel	List Price
X- 50-ES	201-E	50 to 10	7	2	2 3/8"	\$4.00
X- 75-ES	191-E	75	10	3	"	4.00
X-150-ES	167-E	150	13	5	"	4.00
X-220-ES	168-E	220	14	7	2 7/8"	4.25
X-350-ES	169-E	350	17	11	"	4.75
X-500-ES	192-E	500	21	15	3 1/4"	5.00
X-300-ED	202-E	300	12	10	4"	4.75

each section each section

Note—Type X-300-ED is a double condenser.
Note—Type X-50-ES has adjustable stator plate.
Please use new type numbers when ordering

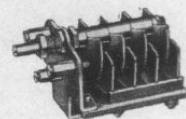
CARDWELL HIGH FREQUENCY NEUTRALIZING CONDENSERS



Type NA-5-NS

Two specially developed condensers designed for neutralization purposes. The plate spacing is extra wide (.218 inches) to permit high flashover ratings. Mycalex is standard insulation on both types.

Type NA-5-NS is recommended for neutralizing type 852 tubes. Type NA-14-NS is recommended for type RK-18 tubes or equivalent.



Type NA-14-NS

Type	Old Type	Max. Cap.	Min. Cap.	Air Gap	List Price
NA- 4-NS	519-2	4	2.5	adjustable	\$3.60
NA- 5-NS	519	5	2.8	.218	3.60
NA-14-NS	519-8	8	5	.218	5.00

CARDWELL ROTOR LOCKING DEVICE



Designed for use where dial or knob adjustment from the front of panel is not required. Mounting angles can be supplied for sub panel mounting of condensers to suit requirements.

Price Each .60 List

Extra Charges for Mycalex Insulation Supplied on Cardwell Condensers

The following condensers are regularly supplied with the Cardwell special insulating compound. If Mycalex insulation is desired please specify the condenser by type number with "Mycalex". Prices shown are net prices not subject to discount and must be added to net selling price of the condenser.

Following Types 50c Extra Net	MR-25-BS	MR-80-BS	MR-70-BS	MR-105-BS	MR-150-BS	MR-260-BS	MR-365-BS	MT-20-GS	MT-35-GS	MT-50-GS	MT-70-GS	MT-100-GS	XT-220-PS	XG-25-KS	XG-50-KS	XR-50-PS	XR-100-PS	XR-150-PS	XR-250-PS	XR-375-PS	XR-500-PS	XR-1000-PS	XR-50-HS	XR-90-HS	XR-140-HS	XR-250-HS	XR-350-HS	XR-500-HS	MR-25-BD	MR-50-BD	MR-70-BD	MR-100-BD	MR-150-BD	MR-260-BD	MT-20-GD	MT-35-GD	MT-50-GD	MT-70-GD	Following Types \$1.00 Extra Net	FT-250-YS	FT-420-YS	MT-150-GS	XR-1000-HS	Following Types \$1.50 Extra Net	XT-440-PS	XT-210-PD	XG-110-KS	XP-330-KS	XE-240-KS	FS-220-YS-2.00	FT-1000-YS-3.00
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All other types not listed here have Mycalex as standard insulation.

HOW TO IDENTIFY CARDWELL CONDENSERS

Every condenser in the Cardwell line has been re-styled so that identification will be a simple matter of interpreting the letters and the numerals in the type numbers. Every letter and numeral in the type number has a direct bearing upon that individual condenser. For example, the first letter in the type number indicates

the frame in which the plates are housed; the second letter indicates the air gap; the numerals indicate the maximum capacity of the condenser; the third letter indicates the type of plate used and the fourth letter the unit such as single, double or triple. The following chart will identify every condenser listed in this catalogue.

Frame	Air-Gap	Capacity	Plate	Unit
M—Midway	A—.218	Expressed in numerals which indicate maximum capacities each condenser.	A—Trim-Air .020	S—Single
X—Standard	C—.200		B—Midway plain .025	D—Double
T—Standard (large ex. 16-B)	E—.100		C—Midway plain cutout "C" type	T—Triple
Z—Trim-Air	G—.171		E—Taper plate	
N—Neutralizing frame (ex. 519)	J—.168		G—Midway rounded .040	
F—Fixed (small size square)	K—.230		H—Standard plain cutout "C" type	
H—Fixed (large 166 frame)	L—.294		K—Standard rounded .040	
G—166 (variable frame)	P—.084		N—Midway modified .040	
W—1666 frame all types	R—.031		P—Standard Plain	
	S—.1535		R—16-B .050 rounded corners and cutout stator	
	T—.070		S—Trim-Air .040	
	U—.020		T—Trim-Air split segment	
	V—.060		U—16-B .050 Aluminum	
			X—Standard .040 rounded modified	
			Y—Small fixed square aluminum	

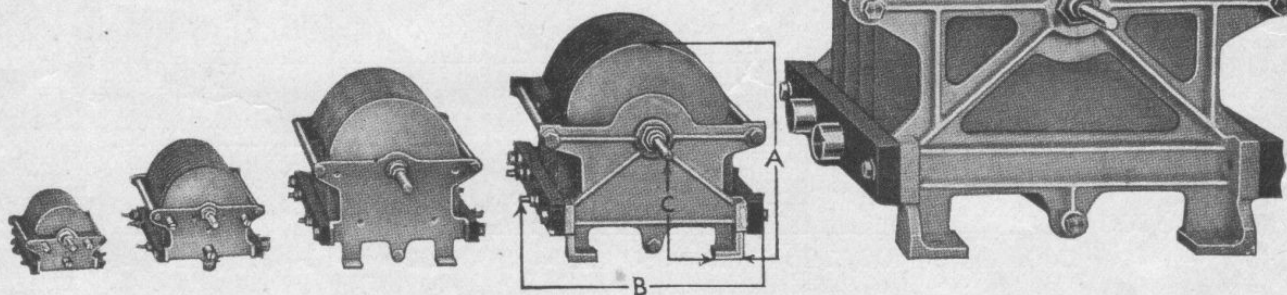
COMPARATIVE RANGE OF SIZES

All Models (excepting "Trim-Air")

Overall Panel Space Dimensions

(See Below)

	Dimension A	Dimension B	Dimension C
Midway	2 1/8"	3"	1 1/16"
"Standard"	3 3/8"	4 1/16"	1 15/16"
Cons. Design 16B T	5 3/8"	6 1/8"	3 1/8"
" " 166B C	6 7/8"	8"	4"
" " 1666B W	14"	15 1/2"	8 1/4"



Midway
"M"

All condensers with letter "M" as the first letter in the type number.

Standard
"X"

All condensers with letter "X" as the first letter in the type number.

Const. Design 16-B
"T"

All condensers with letter "T" as the first letter in the type number.

Const. Design 166-B
"G"

All condensers with letter "G" as the first letter in the type number.

Const. Design 1666-B
"W"

All condensers with letter "W" as the first letter in the type number.



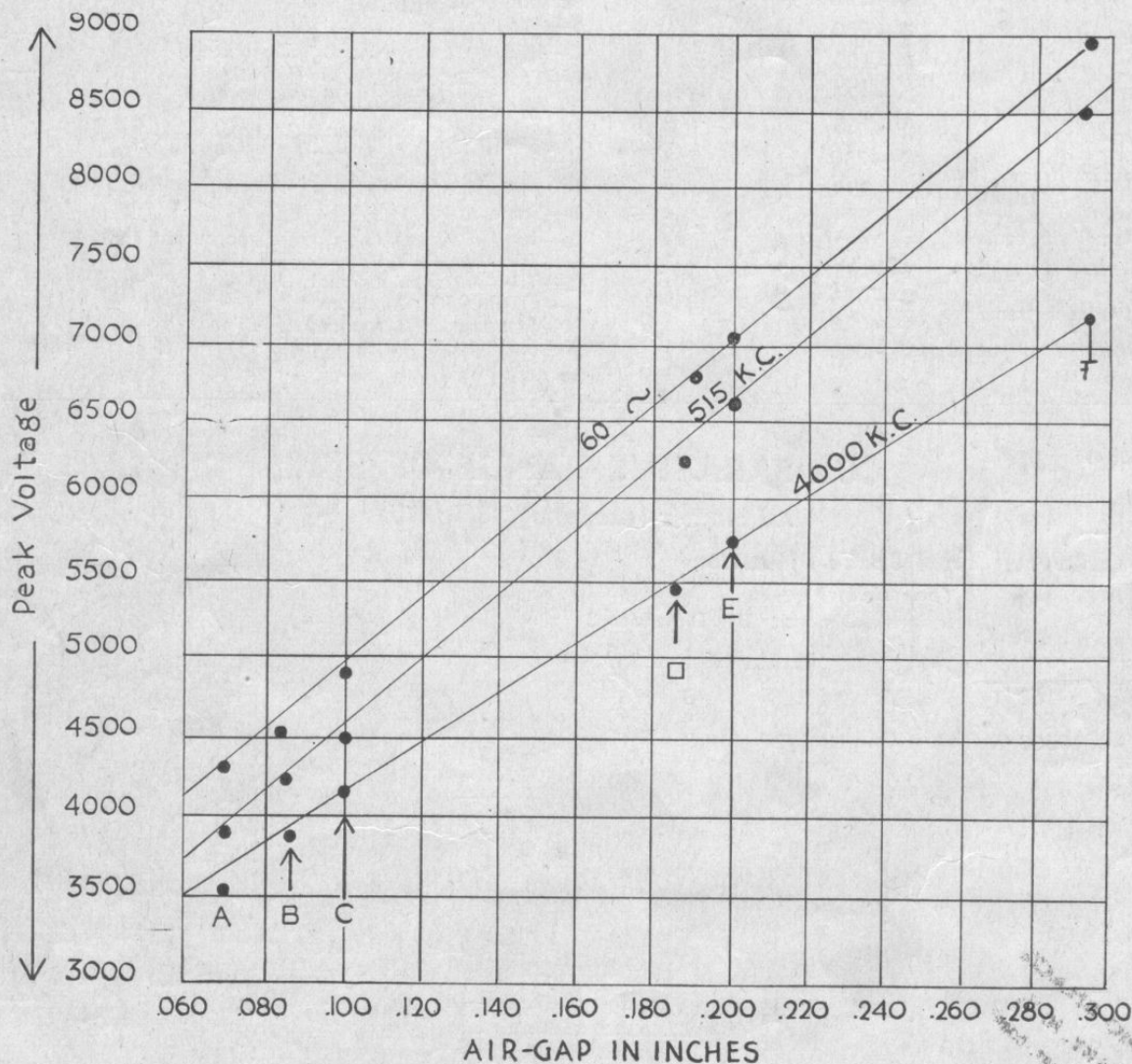
THE FACTS ABOUT BREAKDOWN VOLTAGES OF AIR CONDENSERS



There seems to be an increasing tendency on the part of the purchaser of transmitting condensers to ask for a condenser with a given voltage breakdown rating. The reputation of the Cardwell Company was built upon strict adherence to engineering facts. We refuse to list flashover voltages which are misleading or exaggerated. It is quite possible to list breakdown voltages which are based upon frequencies that are never used in high frequency transmission. Thus a condenser may appear to have an excellent safety factor but will flash over at

voltages well below the rated potential when used in a high frequency tank circuit.

This chart is published so that the purchaser may know the facts. The chart was not wholly created by Cardwell Engineers. It is based on actual measurements and data supplied by recognized laboratories and radio engineers. It applies to any condenser of good workmanship and design. You may depend upon its accuracy and be truthfully guided. Cardwell condensers will measure higher on this chart than most others, due to Cardwell engineering and patented construction.



**PEAK BREAKDOWN VOLTAGE OF VARIABLE AIR
CONDENSERS WITH POLISHED PLATES
HAVING ROUNDED EDGES**

The curves are correct for plate thicknesses ranging from about .025" (A) to .062" (F). Thinner plates reduce the flashover voltage by 8% or more. Square-edge plates reduce it by as much as 20%. Other design features also modify the result and for convenience in making comparisons definite points have been shown for the following Cardwell condensers, A—type MT-150-CS, B—type XP-330-KS, C—type XE-240-KS, D—type XG-110-KS, E—type XC-100-XS, F—type TL-80-US. Note that there is about an 8% difference between the 60-cycle flashover voltage and the 515 kc. breakdown, and a

15% difference between the 60-cycle breakdown and that at 4000 kc.

The chart is used as follows. Begin with the d.c. plate voltage of the tube, multiply by three, and from the chart pick off a condenser with that flashover voltage at radio frequency, using the center curve for the broadcast range, the lower one for short waves. If the tube is PLATE modulated, multiply plate voltage by four, then use the curve as before.

SPLIT STATOR CONDENSERS

The use of the two sections in series increases the flashover voltage. (In a series of measurements made on Cardwell condensers with airgaps of .07" to .218" the flashover voltage for two sections so connected was from 1.6 to 2.1 times that of one section alone.)