Film-Tech

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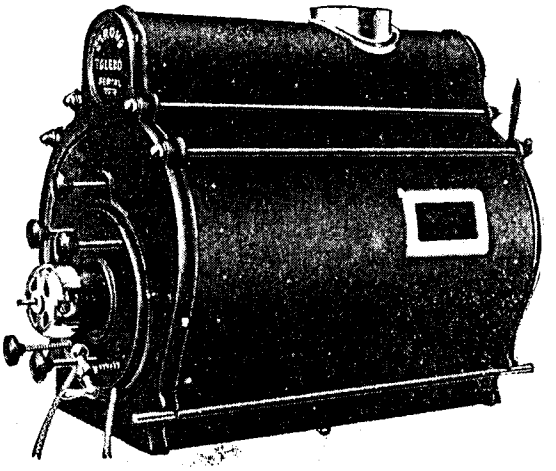
STRONG

STANDARD
LOW INTENSITY
AUTOMATIC REFLECTOR

ARC LAMPS



INSTRUCTIONS
For Installation and Operation

Bulletin No. 23

THE STRONG ELECTRIC CORP.
Manufacturers of
Motion Picture Projection Apparatus
2501 Lagrange St. Toledo, Ohio

"YOU CAN'T GO WRONG WITH A STRONG"

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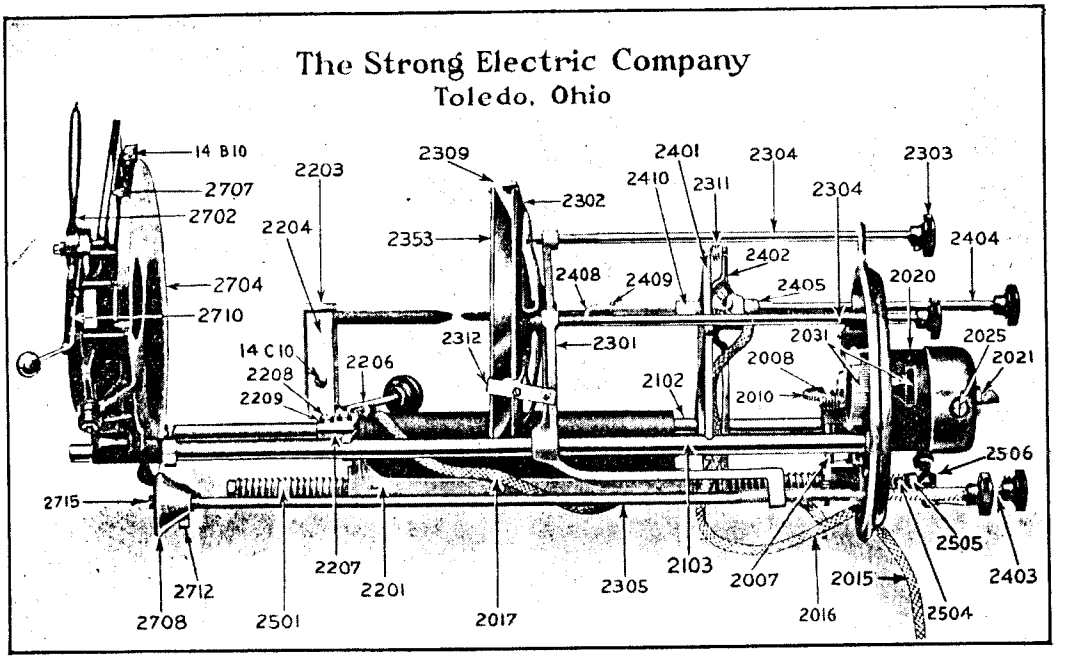

FIG. 1

2003—Lead Wire Bushings	$ .20	2401—Negative Carriage	3.50
2004—Lead Screw Ball Bearings	.50	2402—Negative Spider	4.00
2007—Worm Gear Shaft	.20	2403—Negative Adjusting Rod, Lower	.30
2008—Worm	.30	2404—Negative Adjusting Rod, Side	.30
2010—Worm Gear	1.00	2405—Negative Insulator, Bakelite	.25
2012—Terminal Block Assembly	~~$50~~ 300	2405-A—Negative Insulator, Porcelain 4 in. Stereo. Condenser	.30 1.00
2019—Wire Lug	.05	2408—Negative Jaw Spring	.30
2020—Motor Field	20.00	2410—Negative Jaw Assembly	4.00
2021—Armature	20.00	2501—Lead Screw	4.00
2022—Motor Ball Bearings	1.20	2503—D. Washer, Large	.10
2023—Motor Brush & Springs	.25	2504—Clutch Tension Spring	.20
2025—Motor Brush Holder	.75	2505—D. Washer, Small	.10
2026—Brush Holder, Cap	.25	2506—Ball Crank	1.00
2027—Field Mounting Screws	.10	2507—Ball Crank Nut	.10
2028—Motor End Bell	4.00	2602—Top	1.00
2029—Motor Inspection Plate	.30	2603—Baffle Plate	.85
—Arc Control Assembly	50.00	2604—Vent Stack	1.50
2031—Control Motor Rheostat	2.50	2605—Acorn Nut	.10
2133—Ammeter	7.50	2607—Drop Pan	.75
—No. 8 Asbestos Lead Wire, per ft.	.15	2608—Window Frame	1.00
2102—Slide Rod 21½"	1.50	2609—Window Glass	.25
2103—Slide Rod 24⅛"	1.60	2613—Door Assembly, Right	4.00
2203—Positive Jaw Frame	2.25	2614—Door Assembly, Left	4.00
2204—Positive Jaw Clamp	.35	2615—Pilot Lamp Switch	.75
2205—Positive Jaw Spring	.25	2704—Stereopticon Attachment Assembly	20.00
2206—Positive Clamp Screw	.35	2700—Plain Nose Assembly	4.00
2207—Positive Insulator	~~$1~~ 100	2702—Dowser	1.00
2208—Positive Frame Mounting Screw	.10	2703—Dowser Catch	.25
2209—Positive Screw Bushing	.15	2709—Dowser Catch Pin	.10
—Positive Jaw Assembly	4.00	2707—Slide Carrier	1.00
2301—Reflector Carriage	3.50	2708—Stereopticon Adjusting Cone	1.25
2302—Reflector Frame	4.00	2710—Stereopticon Dowser	.25
2303—Reflector Adjusting Knob	.30	2711—Stereopticon Set Collar	.25
2304—Reflector Adjusting Rod	.35	2712—Roller Bearing	1.00
2305—Reflector Focus Rod	.50	1032—Set Screw, Cup Point	.20
2309—Reflector Clip	.10	2715—Set Screw for Cone	.20
2310—Reflector Focus Rod Spring	.10	2715-A Shoulder Screw for Stereo Roller	.20
2311—Reflector Adjusting Spring	.10	No. 8 Motion Picture Cable, per foot	.15
2312—Reflector Catch & Spring Assembly	.25		
2353—8" Elliptical Reflector	15.00		

INSTRUCTIONS
For Installation and Operation

THIS BOOK OF INSTRUCTIONS was prepared especially for use in the projection room—keep it near the lamp and study it thoroughly and often.

TROUBLE, is generally the result of a dirty lamp or improper adjustments.

WHEN WRITING THE FACTORY regarding installation or trouble always explain in detail and give the exact nature of the difficulty.

Be sure always to state the number of amperes used, the make of carbon and the source of power.

A pencil sketch of your hook-up along with name plate data of your motor generator or rectifier will materially assist us in making recommendations.

WHEN ORDERING PARTS be sure that you give the model of the lamp as well as the serial number.

STRONG PRODUCTS ARE GUARANTEED to be free from defects of materials or workmanship when used normally and within their rated capacity. Our obligation under this warranty is limited to replacement at our factory of any defective part which shall, within one year after date of sale, be returned to us with transportation charges prepaid and which upon our examination shall prove to have been defective.

NO WARRANTY whatsoever is given in respect to carbons, reflectors, condensers, rectifier tubes, or any other accessories not of our manufacture. These parts are usually warranted separately by their respective manufacturers. However, we shall be pleased to assist in securing satisfactory adjustment of any just claims arising from their use.

CLAIMS resulting from damages in transit must be taken up immediately with the carrier upon receipt of merchandise. Our responsibility ceases upon acceptance by them.

SETTING UP STRONG LAMPS on Simplex, R.C.A. or Holmes Projectors, requires only that the lamp be placed on the lamphouse table and fastened down with 5/16"-18 retaining screws. On other projectors, where slide rods are used to carry the lamphouse, it will be necessary to use one of our adapters. See—*Adapters.*

After the electrical connections are made, the optical system should be carefully lined up. Next, the stop collars on the projector slide rods should be set so the lamp will stop exactly in line with the film aperture when the lamp is returned from the position required for projecting slides. See—*Adapters, Projecting Stereopticon Slides.*

ADAPTERS for attaching Strong Lamps to Projectors are supplied at an extra charge of $6.00 each. These Adapters are regularly stocked at the factory in the following models:

Powers 6-B	with 8½" between slide rods	No. 2930
Powers 6-A	with 8" between slide rods	
Powers 6	with 6¼" between slide rods	No. 2931
Motiograph "F" (DeLuxe)	with 9⅜" between slide rods	No. 2902
Motiograph "E"	with 7⅞" between slide rods	No. 2901
Motiograph "D" (Old Model)	with 7⅞" between slide rods	No. 2905
Western Electric	same as Motio DeLuxe	No. 2902
Superior		No. 2915
Baird		No. 2910

R.C.A. —no adapters required
Holmes—no adapters required
Simplex—no adapters required
Fulco —no adapters required

See—*Powers Projectors* designed for type "E" Lamphouses.

POWERS PROJECTORS, designed to use the Type "E" Lamphouses, require raising of the rods upon which the lamphouse bracket slides forward and back. Raising these rods is accomplished by reversing (turning upside down) the brackets on the projector stand that hold the rods. In this way the proper distance between the lamphouse carriage and the optical center is secured.

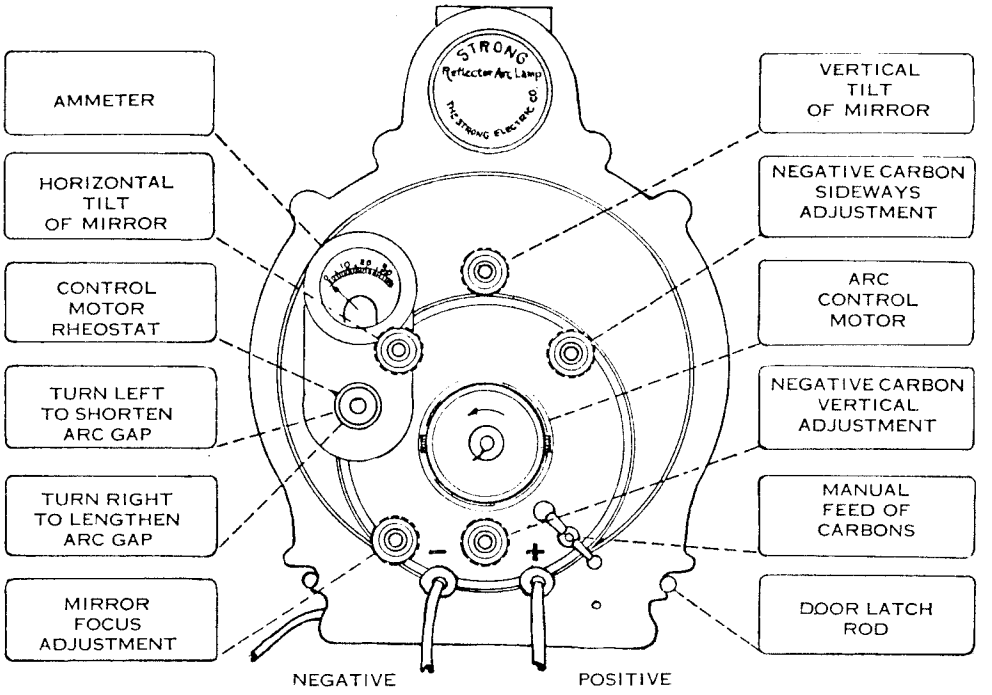

FIG. 2

When ordering adapters for Powers, 6-A Projectors, the center distance between slide rods should be checked with the above list to determine if adapter 2930 or 2931 is needed. See *Adapters.*

THE ELECTRICAL CONNECTIONS are marked for polarity on the rear lamphouse casting above where the wires lead from the lamphouse. (See Figure 2.) These lead wires should be connected directly to the switch under the lamphouse table. This switch must be supplied with a direct current source of power. When this power is from a direct current City Service, it will be necessary to use ballast rheostats. (See paragraph on *Ballast Rheostats.)*

When a generator or rectifier, designed especially for arc lamp operation is used, such equipment should be installed according to instructions furnished with the equipment.

When considering the utilization of your present generator, we advise that you send us complete name plate data, stating

whether the generator is of series or multiple type, together with a sketch of your connections. We shall then submit instructions for making necessary changes.

See—*Electrical Connections, Ballast Rheostats, Emergency Power, Rectifiers.*

THE REFLECTOR No. 2353 must be carefully placed in its holder 2302 through the left hand lamphouse door. The reflector is securely held in place by a spring latch device 2312. The latch is designed to permit free expansion of the reflector, thus preventing undue strain and possible breakage.

The reflector is designed to focus properly when its center is 4″ from the arc crater and the lamp set with the center of the reflector approximately 23″ from the film aperture of the projector. Each reflector has been carefully inspected and actually tested in a lamp, after which it is given a serial number. This number is recorded before the reflector is shipped from the factory. See—*Cleaning the Reflector, Optical System of the Strong Lamp.*

REFLECTOR ADJUSTMENTS for the proper aligning of the spot to the film aperture are made by turning one or both of the knobs at the end of shafts 2304 projecting through the rear of the lamphouse. The position of these knobs and adjusting shafts is best understood by referring to Figures No. 1 and 2. See—*Focusing the Reflector, Optical System of the Strong Lamp.*

THE CARBON SIZES and combinations recommended for various amperages are listed below:

Amperes	Positive	Negative
16 to 18	10MM x 8″	7MM x 8″
24 to 26	12MM x 8″	8MM x 8″

The carbon and current combinations given above are the ones generally used and most satisfactory. There is a definite amperage at which each carbon size is most efficient. It must be remembered that increasing the carbon sizes requires a relative current increase to secure the same satisfactory operation and quality of light. As an example, it would be necessary to operate a 12MM carbon at 23 to 25 amperes to secure the same relative efficiency as a 7MM carbon working at 16 amperes. See—*High Amperages, An Irregular Shaped Spot, Unequal Burning of the Carbons, Strong Jr. Lamp.*

HIGH AMPERAGES, requiring 9MM negative and 13MM positive carbons, are not recommended for reflector arc lamps. The optical system of a reflector arc lamp is designed so the crater of a 12MM positive carbon will project a spot large enough to completely cover the film aperture. Increasing the size of the positive carbon to 13MM only enlarges the size of the spot at the film aperture—without increasing the brilliancy of the spot or light upon the screen.

It is impossible to focus down the spot from a 13MM carbon so as to just cover the film aperture. Consequently, when a 13MM carbon is used, the excessive size of the spot results in destructive heating of the projector mechanism.

By the use of large carbons, and consequent high amperages, control motor reversing may occur. This subject is treated under *Control Motor Reversing.* See also *Carbon Sizes, Losing the Arc, Unequaled Burning of the Carbons, Noise.*

SPECIAL CARBONS, that will carry 30 amperes or more without penciling, are sold under various trade names such as National S.R.A., Bio S.A., Sun Arc, etc. These carbons are manufactured in 8 MM negative and 12 MM positive sizes. These special carbons should be used where more light is required than that secured from the regular grade 12 MM positive when working at the limit of its carrying capacity, which is about 24 amperes.

The use of these special carbons will require that shunts be installed as explained in paragraph on *Control Motor Reversing* and illustrated in Fig. 7. See, *Penciling, Proper Arc Length.*

TRIMMING THE NEGATIVE requires an 8 inch negative carbon inserted in its holder 2410. Proceed as shown in Figure 3 after first separating the carbon carriages to the end of their travel by turning the ball crank 2506. (Fig. 1.) Then while holding the pointed end of the negative carbon in the right hand, pass the opposite end through the center hole in the reflector and thence into the carbon jaw 2410. The forefinger of the left hand should now be hooked behind the carbon at its extreme end (see A Fig. 3) to slightly pull open the carbon jaw spring 2408. This allows the carbon to be pushed back into the holder to the stop pin 2409. The finger position shown at A must be at the extreme end of the carbon and directly behind the jaw spring

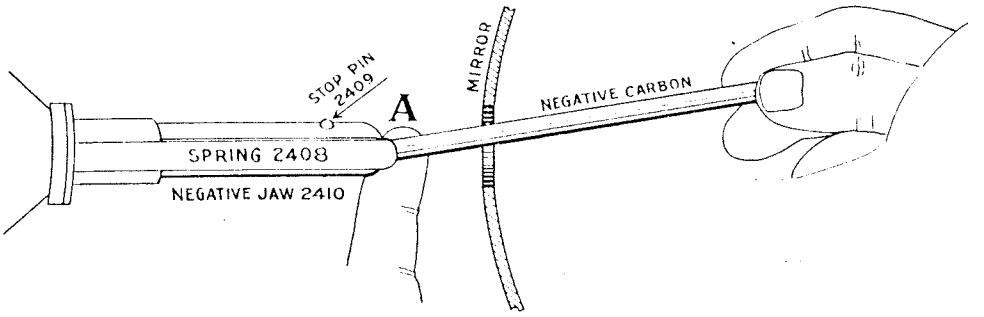

FIG. 3

2408. By observing this precaution no trouble will be experienced by breaking carbons while trimming.

TRIMMING THE POSITIVE requires the insertion of an 8 inch positive carbon in the positive carbon holder 2203, (Fig 1). This holder is located at the end of the lamp farthest from the control motor.

By placing the carbon so the outer end is flush with the front face of the holder 2203 (as shown in Fig. 1) a complete trim can be burned without resetting the carbon. After being placed, the carbon should be firmly clamped by turning the insulated carbon holder clamp screw handle 2206. Caution must be used not to exert unnecessary pressure.

When using positive carbons too large to be easily inserted in the holder or too small to be properly clamped, it will be necessary to adjust the machine screw 14C10 (Fig. 1). This screw will be found half way up on the positive carbon jaw 2203.

BURNER ADJUSTMENTS are made by means of the rods 2403 and 2404 projecting through the rear of the lamphouse. These are illustrated in Figure No. 2. The handles most often used are the ones which control the carbon alignment and these are placed nearest the operator.

TO STRIKE THE ARC proceed as follows: First accurately line up the negative carbon with the positive. (Study carefully Fig. 1).

Then, separate the carbon carriages to the limit by turning the crank 2506 to the left,—a space of about 3/8 inch between carbon tips will result. Now, close the lamphouse table switch—this starts the arc control motor.

By now turning the crank handle 2506 to the right bring the carbons slowly together to "strike the arc"—then separate the carbons quickly until the arc gap is about 5/16" wide. See—*The Proper Arc Length, Rheostat, The Principle of the Arc Control.*

THE PROPER ARC LENGTH should be such that the voltage across the arc will be from 50 Volts at low amperages to 56 Volts at high amperages. At these voltages the arc should burn steadily and the distance between the carbons will be about 5/16". When copper cored carbons are used, the distance between the carbons should be the same as above, but the voltage drop across the arc will be found to be slightly lower. See—*To Strike the Arc, Copper Cored Negative Carbons, Too Short An Arc, Rheostat.*

THE SPOT at the film aperture should be nearly round, sharp edged, and adjusted to such a size that a perfectly flat field is projected onto the screen. For best results, the size of the spot should be adjusted to the focal length of the projection lens used. The brightest light on the screen, with the flattest field, can not always be secured by adjusting the reflector to produce the smallest spot at the film aperture, but the spot size must be adjusted for the particular objective lens used. The best guide for the size of the spot is observing the brilliancy of the light on a flat screen. See—*Focusing the Mirror.*

AN IRREGULAR SHAPED SPOT may be caused by an irregularly burned crater. Too low an amperage for the carbon size produces a crater which is not round or well filled out.

When too high an amperage is used the arc will be unsteady, and tend to sputter, thus preventing the formation of a well shaped crater.

Generally, we attribute an irregular spot to improper alignment of the negative with the positive carbon. When the carbons are out of line, the face of the positive crater does not burn parallel with the face of the mirror. The negative carbon should be set slightly lower than the positive (about 1/16") so the positive carbon will burn with a cup shaped crater that is square with the face of the mirror.

When the negative carbon is set too low a lip will be formed on the upper edge of the positive carbon as illustrated in Fig. 4.

FIG. 4

Carbon Photographs by Courtesy of The National Carbon Company

The condition illustrated above produces an irregular shaped spot and a large portion of the light will be thrown downward.

When the negative carbon is set too high a lip will be formed on the lower edge of the positive carbon and the light will be thrown upward. This condition will also produce an irregular spot as a result of the irregular burning of the positive carbon. The result of setting the negative carbon too high is illustrated in Fig. 5.

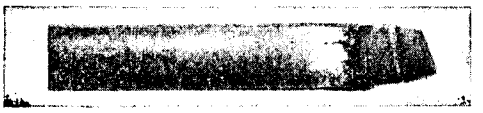

FIG. 5

Occasionally, an irregular or eggshaped spot may be corrected by slightly rotating the reflector in its holder—so that the long dimension of the spot is in line with the long dimension of the aperture. See—*Carbon Sizes, Too Low Amperage, Too High Amperage.*

LOSING THE ARC may result from any one of the following causes:—improper adjustment of arc control motor—mechanical features such as dirty or bent slide rods—dirty motor ball bearings—excessive drafts from theater ventilating systems —too high amperage, causing reversal of the arc control motor—a generator equipment having too low a voltage.

It is very essential that the sliding parts and adjusting screws of the lamp be kept clean, bright, and free from oil, as the heat of the arc will cause oil to gum and readily combine with grit from the burning carbons.

Drafts through the lamphouse may be strong enough to seriously interfere with stable operation of the arc and may even

extinguish it. The installation of a damper in the lamphouse stack will govern this condition.

High Amperage may cause the arc control motor to reverse even to the extent of putting out the arc. For correction of this trouble, see paragraphs *High Amperage, Control Motor Reversing.*

If the generator or rectifier equipment has less than 80 volts it will be impossible to carry an arc of satisfactory length—and frequent loss of the arc will occur. See — *Cleanliness, High Amperage, Control Motor Reversing, Intermittent Feeding of the Carbons, Unequal Burning of the Carbons, Oil, Adjustment of the Clutch.*

TOO HIGH AMPERAGE causes penciling of the negative carbon (see Fig. 6) and hissing or blowing of the positive. This unstable operation of the arc tends to cause erratic operation of the arc control motor and may even reverse the motor until the arc is lost.

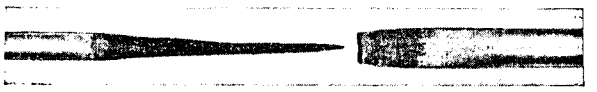

FIG. 6

Stable operation of the motor, under the above conditions, is re-established by use of a current field shunt as explained under paragraph *Control Motor Reversing.* See also — *Penciling, Mushroom Tip, Losing the Arc, An Irregular Shaped Spot.*

TOO LOW AMPERAGE for the size of the carbon used will not produce a completely filled-out positive crater area—resulting in a poor light and wandering arc. If less than 13 Amp. are used, the arc control motor will feed the carbons too close together. See—*Too Short an Arc, Carbon Sizes, An Irregular Shaped Spot, A Wandering Arc, The Proper Arc Length.*

TOO SHORT AN ARC causes unstable burning and mushrooming of the carbon tips.

If 12 Amp. or less are used, the control motor will tend to feed the carbons too close together regardless of motor rheostat

setting. The remedy for this condition is to increase the current to 13 amperes or more. The control is not designed to operate under 13 amperes. See—*The Proper Arc Length, Mushroom Tip, Too Low Amperage, Rheostat.*

CONTROL MOTOR REVERSING, or "acting erratic," usually results from too high amperage, (23 amperes or more). It may also be due to the use of copper cored negative carbons which may cause unbalancing of the differential field windings of the Control Motor.

When starting a cold generator the current may be high until the generator gets warmed up. When a new trim of S. A. carbons is lighted the amperage may also be high causing the control motor on the lamp to reverse, but the motor will feed ahead as soon as the carbons are burned in or the current becomes normal.

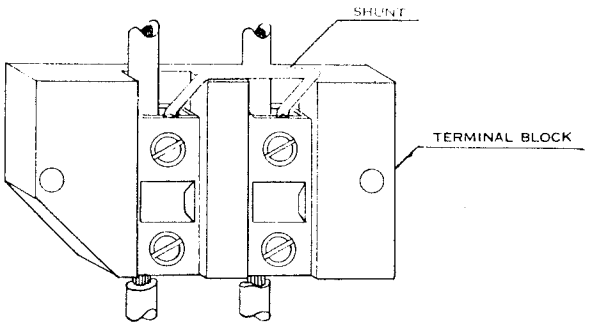

FIG. 7

Trouble of this nature can be prevented by installing a special current field shunt which will be supplied from the factory free of charge. The shunt should be connected across the terminals, which are mounted on the terminal blocks located inside the lamphouse. As shown in Fig. 7, the shunt is connected across the terminals by first loosening the top set screws and then inserting the shunt in with the wires, after which, the screws are firmly tightened again. The shunts are to be used to re-establish equilibrium in a motor which may be acting erratic because of improper operating conditions or deviation from standard operating practice. See — *Too High Amperage, Copper Cord Negative Carbons, Losing the Arc, The Principle of the Arc Control System, The Control Motor, Noise.*

PENCILING OR SPINDLING of the negative carbon (as illustrated in Fig. 6) is the result of an overload; that is, using too many amperes for the particular size carbon. Carbons have physical limitations. Consequently, if a 7 M.M. carbon, designed to carry 17 Amp., is burned at 20 Amp. the natural result will be short life and spindling. Reducing the current to the proper amperage is all that is necessary to correct this trouble. Always remember that spindling is caused by too much amperage for the particular size carbon used. The result of using too high amperage is shown in Fig. 6 and the effect of reducing the amperage to its proper value is shown in Fig. 8.

FIG. 8

In some cases it is possible the ammeters on your lamps, which probably have not been calibrated since they were installed, may not be reading correctly and you are getting more amperes than the instrument indicates. See paragraphs—*Ammeters, Carbon Sizes, Too High Amperes.*

A MUSHROOM TIP on the negative carbon is produced by too short an arc, and is referred to as "freezing." This trouble is due to particles of the positive carbon being carried across through the arc stream and deposited on the tip of the negative carbon. See Fig. 9.

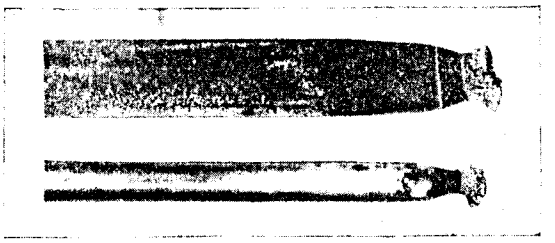

FIG. 9

By turning the arc control rheostat handle to the right (or clockwise) (see Figs. 2-1), the control motor speed will be automatically reduced until the necessary longer arc gap is established and then the mushroom tip will be burned away. See—*Too Short an Arc, Too Low Amperage, Rheostat.*

HISSING is caused by too short an arc gap, which prevents the formation of a perfect positive crater and results in an unsteady light on the screen. Hissing may cause the carbon tips to mushroom and it will also produce erratic operation of the arc control motor. See—*Too Short an Arc, Control Motor Reversing, Too High Amperage, A Mushroom Tip.*

ARC SPUTTERING is usually caused by one of two things —either wet carbons or impurities in the carbons. Carbons because of their porous structure may absorb moisture while in transit or storage. If sputtering is experienced the carbons should be carefully dried.

Impurities in a poor quality carbon will cause unstable burning and sputtering at the arc, and result in erratic operation of the arc control motor. See—*Control Motor Reversing.*

A WANDERING ARC is the result of using too low amperage for the size of the carbons. See—*Too Low Amperage, Carbon Sizes.*

BURNED OUT POSITIVE CARBON CORE, that is, a deep hole burned in the middle of the positive crater, is caused by one of three things.—The current is so high that it blows the core out of the positive carbon.—The current is so low that the soft core material is consumed faster than surrounding shell.—The carbon is too large for the current used. See—*Too High Amperage, Too Low Amperage, Carbon Sizes.*

INTERMITTENT FEEDING OF THE CARBONS, indicated by stopping and starting of the motor while the arc is burning, can be observed by the "Tell-tale" tab on the end of the arc control motor shaft 2021. The motor should run continuously—feeding the carbons uniformly as they are consumed.

Motor running without feeding of the carbons is probably due to slipping of the clutch. If this trouble should occur it will only be necessary to tighten the clutch spring by means of tension nut 2505.

Mechanical binds, due to dirt, rather than electrical troubles are in practically all cases the cause of unsteady feeding of the carbons. If the slide rods become dirty they may retard the

movement of the carbon carriages to such an extent that the clutch slips. If this should occur the carbons will not feed even though the motor is running.

In rare cases an open circuit in the armature may cause intermittent feeding of the carbons because the motor will not start readily if it has stopped with the dead commutator segment under either of the burshes.

It may appear that the motor is not feeding the carbons when the control motor rheostat is set for too long an arc.

Too much spring tension on the motor brushes may also cause intermittent feeding. See — *Cleanliness, The Control Motor, Brushes, Oiling, Too Long an Arc, Unequal Burning of Carbons, Losing the Arc, Rheostat Adjustments, Friction Clutch, Adjustment of Clutch.*

CLEANLINESS is of paramount importance for the performance of any mechanical device. More especially this is true in an arc lamp where heat and carbon grit from the arc are present.

Don't oil the burner mechanism. All inside parts of the lamp have been nickel plated and designed to operate without lubrication. Any oil put in a lamphouse soon becomes gummy from the arc heat and picks up grit from the carbons as they are burned.

A guard pan is provided to shield the lead screw and slide rods from effects of the heat and grit. A removable pan is also provided that completely covers the bottom of the lamphouse and catches any dirt from the burning arc. This pan should be removed and emptied daily.

All moving parts, and especially the slide rods 2103, 2304, 2404, as well as lead screw 2501, should be kept clean, dry and polished by regular cleaning with a dry cloth In case the rods have become coated and rough from dried oil and lack of care, they should be given a thorough cleaning and polishing with a cloth dampened by kerosene or Pyrene liquid (taken from a Pyrene fire extinguisher). See—*Losing the Arc, Intermittent Feeding of the Carbons, Oiling, Cleaning the Commutator, Cleaning the Reflector, Control Motor Repairs.*

CLEANING THE REFLECTOR daily is essential. The whole optical efficiency of the lamp depends on the cleanliness of the reflector surface. Clean the reflector daily (but always when it is cold). A dampened chamois should be used to remove any dullness from the glass surface, after which it should be polished with clean cheese-cloth or tissue paper. Paper sold under the trade name "Kleenex" or "Ponds Tissue" can be secured at most drug stores. Be careful not to wet the backing of the reflector.

Through lack of care the reflector may become dull and covered with a white deposit that is difficult to remove with water alone. This film may be removed by using a good silver polish—we recommend Wrights Silver Cream which may be secured at most jewelers. See—*The Reflector, Cleanliness.*

RESILVERING OF 8″ REFLECTORS will be done at $5 each.

CLEANING THE COMMUTATOR should be done while running the motor at high speed. To secure this high speed, it is necessary to turn the current into the lamp while the carbons are separated and the arc not burning. The motor inspection plate is first removed and the commutator cleaned by means of a clean cloth. The cloth should be held against the commutator with the little finger inserted through one of the holes in the motor end bell.

Never use Sandpaper fastened to a stick to clean the commutator because of the danger of breaking the fine wires of the armature. See—*Control Motor Repairs, The Control Motor, Noise.*

OIL is essential only on motor worm gears 2008 and 2010, (Fig. 1). Only a drop of oil once or twice a month should be used and any excess oil should be carefully removed.

Be sure to keep oil off the slide rods, adjusting rods 2304, lead screws 2501 and slide rods 2103. These parts should be kept polished and free from oil.

The arc control motor is full ball bearing and does not require oil. If oil should get into the motor it may find its way to the commutator and become so sticky that it causes sluggish intermittent operation of the control motor and possible loss of the arc. Oil in the motor may also clog the brush holders.

Dirt lodged in the motor ball bearing will prevent free turning of the motor (see--*Intermittent Operation of Arc Control* and

Losing the Arc). Should this trouble occur, remove the bearings from the motor and cleanse thoroughly with kerosene until they spin freely, then lubricate each bearing with a drop of light oil and replace.

To remove the bearings, take off the worm gear 2008 from the motor shaft. Then remove motor brushes 2025. Now unscrew the motor retaining screws, the heads of which are inside the lamphouse, and remove the motor end bell. See—*Losing the Arc, Intermittent Feeding of Carbons, Cleanliness, Brushes.*

UNEQUAL BURNING OF CARBONS is generally the result of using carbon size combinations that were not designed to operate together. *(See Carbon Sizes).* Sometimes variations occur in the standard carbon diameter. Naturally there will be a faster burning rate in a carbon just a few thousandths smaller in diameter than the standard.

The negative carbon will be consumed faster than the positive when the amperage is too high. The positive carbon will burn too fast if there are excessive drafts through the lamphouse. See—*Losing the Arc, Carbon Sizes, Too High Amperage.*

CONTROL MOTOR REPAIRS are seldom necessary because of the extreme simplicity of design.

In the event the motor must be taken off for inspection or repair proceed as follows:—remove the two retaining screws, the heads of which are located within the lamphouse, disconnect the lead wires and remove the worm gear 2008 (Fig. 1) from the armature shaft. The complete motor may now be removed as a unit.

THE MOTOR BRUSHES are a special grade selected for this particular motor.

Because of the small size and slow speed of the commutator, and the light tension of the brush springs, the brushes will give years of service without attention.

Never use any other brushes, or brush tension springs, than the ones designed for this motor and supplied through our service. See—*Cleanliness, Oil, Intermittent Feeding of the Carbons.*

THE AMMETERS furnished with Strong Lamps are strictly high grade instruments that with reasonable care will function accurately for a long time. However, they are fitted with jewel bearings and are as delicate as a watch—being easily damaged by rough or careless handling while in transit or use.

A loose connection at the meter binding post will develop heat which in time may destroy the bakelite case of the meter. These connections should be checked occasionally to see that they are tight and not developing heat.

These meters are guaranteed for one year by their manufacturer under their standard warrantee, which, however, specifically states that repairs will be charged for when the meter shows that it has been abused. Minor repairs such as calibration or replacement of broken glass are handled at a fixed charge of $2.00. For major repairs such as burned out elements, broken jewels, etc., there will be a charge of $4.50. See—*Penciling or Spindling, The Strong Arc Control System, The Strong Junior Lamp.*

THE RHEOSTAT, 2031 (Figs. 2 and 10) placed at the left of, and adjacent the arc control motor, is used to establish the length of the arc gap.

Turning the rheostat clockwise (to the right) slows down the motor which lengthens the arc gap. The rheostat turned counter-clockwise (to the left) speeds up the motor and shortens the arc gap. See—*To Strike the Arc, Too Short an Arc, The Strong Arc Control System, Changing the Rheostat Adjustment.*

CHANGING THE RHEOSTAT ADJUSTMENT, as the carbons are consumed, is necessary when the voltage of the generator or rectifier is too low. A horizontal arc does not operate correctly if the generator potential is less than 80 volts.

The best average positions are completely clockwise for low current values and extremely counter clockwise for high current values, with a midway setting for approximately 18 amperes. See—*Electrical Connections.*

BALLAST RHEOSTATS of 110 Volts, and adjustable from 13 to 28 Amperes, must be used when Strong Lamps are connected to a direct current city source of power.

Ballast Rheostats of 80 volts and adjustable from 13 to 28 Amperes must also be used when Strong Lamps are connected to motor generator sets. See—*Electrical Connections, Rectifiers.*

RECTIFIERS, designed specially for use with Reflector Arc Lamps, are simple and efficient and do not require the use of Ballast Rheostats. We issue a special bulletin on the installation and operation of Strong Rectifiers.

Rectifiers, designed for the old straight arc lamps, may be used to carry two Reflector Arc Lamps if one 80 Volt Ballast Rheostat is installed in series with each lamp. See—*Electrical Connections, Ballast Rheostats, Noise.*

LAMPHOUSE DOORS may be adjusted for tension, so the doors close easily and stay closed, by rolling the latch rod at the bottom of the door. To adjust the door tension, the latch rod should be grasped at each end by a pair of gas pliers and rolled until the desired tension is secured between the latch rod and the ears that hold the door closed.

THE PILOT LIGHT must be supplied with an ordinary 110 V. bulb and the lead wires connected to a 110 V. lighting circuit.

THE FRICTION CLUTCH is provided to permit manual striking or feeding of the arc without disengaging the arc control motor. The clutch also acts as a safety device preventing breakage if the motor is allowed to run after the carbon carriages have come to the end of their travel. See — *Striking the Arc, Adjustment of the Clutch.*

ADJUSTMENTS OF THE CLUTCH are made by turning the nut 2505 to vary the tension on spring No. 2504. The tension spring regulates the pressure between the clutch driving disk and the face of the lead screw driving gear.

If the Spring Clutch tension is too strong, it will be hard to turn the ball crank 2506. When the tension is too light, the clutch may slip enough to cause loss of the arc.

See—*The Friction Clutch. Loss of the Arc, Striking the Arc.*

IN SMALL PROJECTION ROOMS where the carbon adjustment rods obstruct the passage behind the lamp, we advise

the use of telescoping adjustment rods. These rods are furnished in sets of four which are sufficient for two lamps. The set of four rods sells for $5.00.

THE STRONG ARC CONTROL SYSTEM is the result of scientific research and years of experiment and development, and it is completely covered by patents. Only in the Strong Arc System are the carbons fed continuously and automatically and at the exact rate at which they are consumed.

Simplicity is the keynote of the Strong Lamp and this is only possible because of the simplicity of the Strong Arc Control System. The arc control consists of just one moving part—the armature which floats on precision ball bearings.

The Strong Lamp because of its simple and rugged construction and patented continuous feed arc control system projects a brilliant, flat and steady field of crisp, white light. See—*Principle of the Strong Arc Control System.*

THE PRINCIPLE OF THE ARC CONTROL SYSTEM OF THE STRONG LAMP consists in utilizing changes in the electrical characteristics of an arc to control the operation of a differentially compounded motor. Operation of the motor results in a change in relative position of the carbon so that a predetermined arc length is maintained. See — *The Strong Arc Control System, The Control Motor, Emergency Power.*

OPERATION OF THE ARC CONTROL MOTOR is illustrated in Fig. 10. In the diagram the large circle denotes the control motor with its field windings and armature. The heavy black lines indicate the current windings, these are heavy wire and carry all the amperes to the arc. The red lines indicate the potential windings, which consist of many turns of fine wire connected directly across the arc.

It is necessary that the two separate field windings be connected so they will oppose each other—for otherwise the motor would revolve in one direction only. If there were only the potential (or red) windings, the motor would always feed the carbons together; if there were only the current (or black) windings, the motor would always draw the carbons apart.

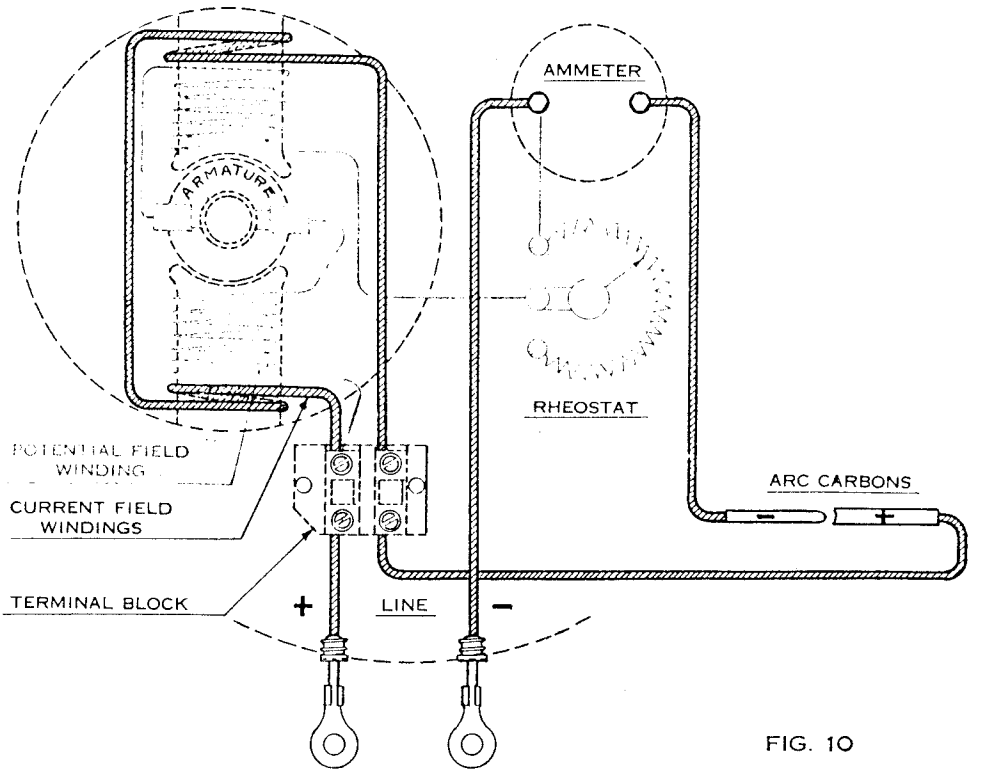

FIG. 10

When the same amount of electricity flows through each of these two windings they oppose each other with equal strength and consequently the motor does not revolve. This balanced condition exists only when the length of the arc is exactly right.

The rheostat is shown in red on the diagram to denote that it forms a part of the circuit of the potential windings. By means of the rheostat a working balance can be established for the various amperages.

Burning away of the carbons results in an increased flow of electricity through the red windings and a decreased flow through the black. Consequently the red windings become stronger than the black and an unbalanced condition, between the strength of the two fields, results. Naturally under this condition the control motor will turn in the direction controlled by the red windings and feed the carbons together.

The farther apart the carbons are separated the more electricity will flow through the red windings, and the faster the

motor will turn—thus automatically controlling the length of the arc by the speed, and direction of rotation, of the control motor. See—*The Strong Arc Control System, The Number of Amperes, The Motor, The Armature, Field Windings, The Rheostat, Emergency Power.*

THE CONTROL MOTOR consists of an armature and differentially wound fields.

The armature is geared directly to the carbon carriage through a gear train in such a way that rotation of the armature will cause the carbons to be fed closer or farther apart depending on the direction of rotation of the armature.

Each of the two field poles of the motor carry two separate windings. One of these windings is called the potential winding (illustrated in red in Fig. 10) and it is made up of 700 turns of fine wire connected directly across the arc. The other winding is called the current winding and it consists of only 7 turns of heavy wire through which all the amperes must pass before reaching the arc. See—*The Armature, The Field Windings, The Number of Amperes, Emergency Power.*

THE MOTOR FIELD WINDINGS are used to produce a magnetic field which will pass through the armature and cause it to rotate in one direction or the other depending upon the direction in which the magnetism is flowing. The potential, or fine winding (as illustrated in red, Fig. 10), is wound in a direction and so connected, that the magnetic field produced by it will cause the armature to rotate counter-clockwise and feed the carbons closer together. The current, or heavy winding, is wound in the opposite direction to that of the potential windings. This produces a magnetic field that causes the armature to rotate clockwise (to the right) and separates the carbons. See—*The Armature, The Control Motor, The Rheostat, The Number of Amperes.*

THE ARMATURE is so connected electrically to the control system that it is electrically energized at all times when the arc is burning, and whether the motor is running or not. The armature being energized at all times, will run in a direction and at a speed that corresponds with the direction and magnetic

strength of the stronger of the two fields. See—*The Control Motor, The Motor Field Windings, The Number of Amperes.*

OPTICAL SYSTEM OF THE STRONG LAMP consists of a positive arc crater located at the geometric focal point of a reflector—See Fig. 11. The mirror is so designed that all the light picked up from the crater will converge to the film aperture without loss due to spherical aberration. With the Strong Reflector, a clean cut magnified image of the arc crater is projected that completely covers the film aperture with light of uniform brilliancy.

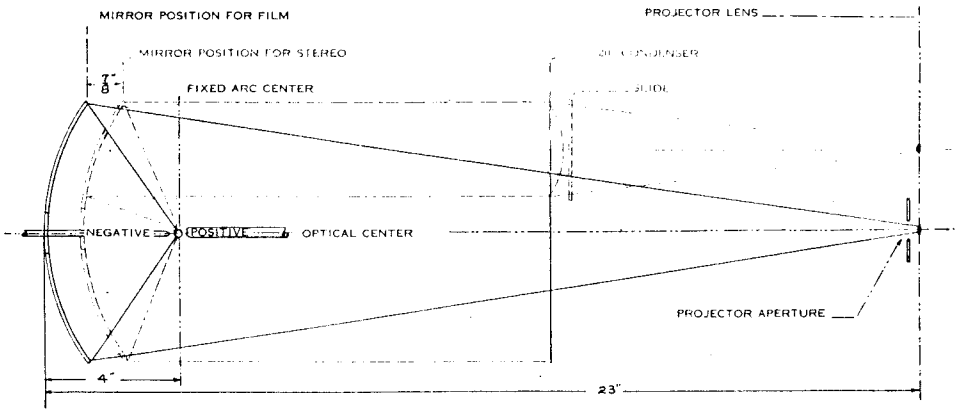

FIG. 11

When stereopticon slides are projected, the patented automatic shifting device moves the reflector closer to the arc crater so that the light will be projected in a parallel beam (illustrated in red Fig. 11), instead of a converging one as when films are projected. A portion of these parallel light rays are picked up and converged by means of a condensing lens so they pass through the stereopticon slide and on through the objective lens to the screen. See—*The Reflector, Reflector Adjustment, Focusing the Reflector, The Spot, Projecting Stereopticon Slides.*

FOCUSING THE REFLECTOR is accomplished by turning the knob on focusing rod 2305. This rod projects through the rear of the lamphouse at the lower left hand corner. The knob should be turned until the spot of light is well defined and just covers the aperture.

Exact focusing to clear up the field should be made while projecting light on the screen. During this focusing, the projector must not be running and it should be without film. See—*The Reflector, Reflector Adjustments, The Spot, Optical System of the Strong Lamp, Projecting Stereopticon Slides, Squaring the Picture.*

EMERGENCY POWER, for use should your generator fail, may be supplied direct from the alternating mains by installing a regular 110 V. adjustable Strong rheostat in series with the line. The undesirable alternating flicker cannot be overcome when using alternating current but there will be sufficient light to carry on the show.

With alternating current at the arc, the carbons must be fed by hand.

Alternating current will not operate the control motor, but neither will it injure it, therefore, the motor will not have to be disconnected if alternating current is temporarily used for the arc. See—*Electrical Connections, The Control Motor, Ballast Rheostats, Rectifiers.*

NOISE should not be picked up in a properly designed sound system. Strong Lamps, because of the absence of arcing relays, should not produce noise in any sound system.

A crackling noise in the sound system may result from sparking at the commutator and may accompany the use of high amperage. This noise can be eliminated by the installation of a shunt as explained under "Control Motor Reversing."

A "sixty cycle hum" may be picked up in the sound system when rectifiers are used. The noise can be eliminated by shielding both the negative and positive lead cables of the lamp with a flexible metallic shield. The frame of the rectifier, and the flexible cable shields, must all be grounded.

A faint clicking noise in the sound system (that is timed with the rotation of the arc control motor) is due to sparking at the commutator. Noise may also be picked up when rectifiers are used—if the lead wires from the rectifier to the lamp are too close to the pick-up device or turntable. See—*Cleaning Commutator, Cleanliness, Oiling, Rectifiers, Control Motor Reversing, High Amperage.*

THE STRONG JUNIOR LAMP is identical in appearance and construction with the standard lamp except for size—it being 3″ shorter, with its other dimensions in proportion.

The Junior Lamp has exactly the same capacity in amperes and carbon sizes and will project exactly the same amount and quality of light as the Standard, because the same Strong Elliptical Reflector is used in both. The same arc control system is employed in each lamp.

The same stereopticon attachment is used on the Strong Junior Lamp that is used on the Standard, but the Junior Lamp is not equipped with pilot light.

Carbons for the Junior Lamp should be 6 inches long. Although the standard 8 inch carbon can be used. When using 8 inch carbons, it will be necessary to reset the carbons once during the trim. See—*Ammeters, Carbon Sizes.*

TO PROJECT STEREOPTICON SLIDES, first, release the spring latch and drop the stereopticon slide attachment into position by swinging it to the left until the latch catches. The lamphouse should now be moved sideways on the carriage rods far enough for the stereopticon slide opening to be in line with the stereopticon projection lens.

Shipped with the lamp, and packed in a box with the reflector, is a 20 inch focus condenser. This condenser should be mounted in its holder behind the stereopticon slide opening.

Note carefully the paragraph "Optical System" and the light diagrams in Fig. 11.

Dropping the stereopticon attachment into place automatically operates the patented attachment that moves the reflector forward about 7/8 of an inch. This forward position of the reflector changes its working focus so the converging beam used for projecting film is changed to a parallel beam that fully illuminates the 8-inch opening in the front of the lamphouse. By this arrangement, a portion of the parallel rays taken from one side of the circle of light projected from the reflector, will pass through the condenser lens and stereopticon slide to the projection lens through which the picture is focused on the screen.

The lamp and stereopticon projection lens are now adjusted, so as to center the picture on the screen. After the picture has been centered, the set collars on the lamp carriage slide rods

should be firmly set. If the projected image on the screen is not brilliantly and uniformly illuminated it will probably be due to improper adjustment of the stereopticon shifting cone 2708.

The shifting cone is set at the factory to move the reflector 7/8 of an inch when the stereopticon attachment is dropped. This distance is approximately correct for the usual installation, but some jobs require special adjustment.

SHADOWS of the edge of the reflector appear in the right hand corners of the picture, if the reflector has not been shifted far enough forward; and a shadow of the carbon jaws will be seen on the left hand side of the picture, if the reflector has been shifted too far forward.

CLEARING THE FIELD is accomplished by adjusting the shifting cone 2708 on the rod 2305. Before attempting to make any adjustments of the shifting cone, the lamp should be returned to its original position for film projection and the spot correctly focused for projecting films. After the spot has been correctly focused for projecting film, push the lamp over again to the stereopticon position, and proceed to adjust the cone. First, grasp the mirror adjustment rod 2305 and hold it so it cannot turn (if this rod is allowed to turn, it will change the adjustment made for film projecting). Second, loosen the adjusting cone set screw 2712 and adjust the cone until the shadows disappear from the picture. Be sure and hold the reflector focus rod 2305 firmly while adjusting the cone and tightening the set screw. See—*Setting up Strong Lamps, Adapters, Optical System.*

SQUARE THE STERIOPTICON PICTURE on the screen by adjusting the stereopticon leveling screw No. 14B10.

INDEX