

2193.

Sources of light.

a. Sunlight.

In order to be able to use sunlight for the experiments described, the instrument has only to be modified by using a heliostat instead of the body of the lantern. All items remain the same, this having the advantage that the same fittings can be used for sunlight as for artificial light. We are indebted to Professor Kucera of Agram at whose instigation this heliostat was constructed. It is constructed both as a wall and as a window heliostat. Where there is much sunshine, but no electric current or illuminating gas, such a heliostat is an advantage as with it all the experiments may be undertaken, the projection of emission spectra of course being excepted; the absorption spectrum of the sun is however a desirable substitute.

2193. **Universal wall heliostat.** [Fig. 1/4 nat. size.] \$ 75,00

A zinc tube is plastered into the wall, the inner end of the tube being closed by a thin metal cover. The heliostat tube is inserted in this zinc tube and screwed fast to the imbedded brass plate. The mirror blackened on one side and silvered on the other, is moved by means of two keys (only one of which is visible in the figure).

All attachments of the universal projection apparatus No. 2132 can be used with this heliostat.

2194. **Universal window heliostat** » 65,00

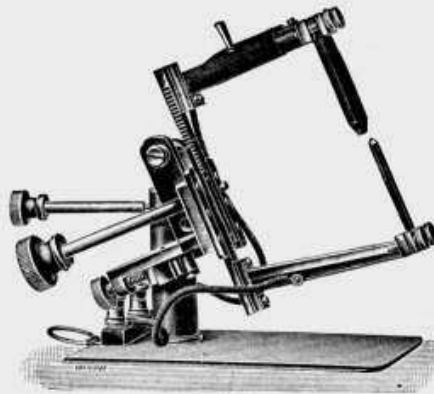
With this the zinc and brass tubes are done away with. The plate, carrying the mirror attachment on one side and the projection attachment on the other, is screwed on to the sash.

This heliostat may also be used with all the attachments of the universal projection apparatus No. 2132.

b. Electric arc light.

Where an electric current of at least 40 volts and 10 ampères is available, the purchase of a good electric lamp can not be too strongly recommended.

Of all artificial sources of light, electric light is the best, on account of its high candle power, compactness, and convenient regulation. A comparison of the different sources of light with reference to their brightness shows immediately the superiority of electric light.



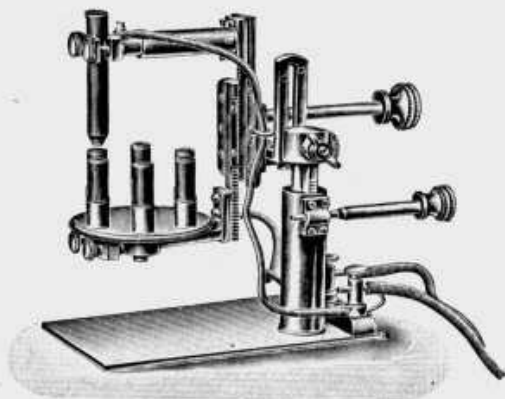
2195.

If the brightness produced on a screen from a four wick paraffin lamp be taken as unity, the following numbers are obtained:

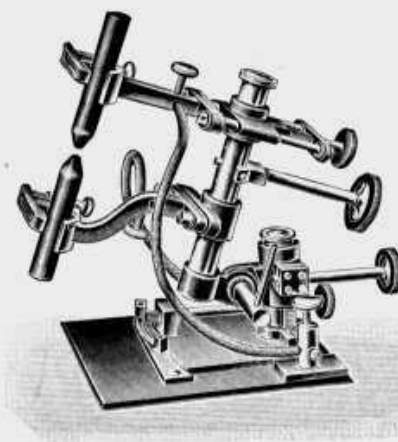
Incandescent gas light	1
Incandescent spirit light	1
Incandescent electric light, 100 candles, focus lamp	4
Lime light, compressed oxygen and illuminating gas	12
Lime light, compressed oxygen and hydrogen	16
Lime light, compressed oxygen and hydrogen with burner 2263	24
Electric arc light according to amperage	40–100

We make electric lamps for automatic feed, for hand feed and lamps that can be regulated both automatically and by hand. Automatically regulated lamps have the advantage that these lamps do not require attention during a demonstration. They possess, however, as compared with hand fed lamps, the following disadvantages: On the one hand, if the regulating mechanism is a complicated one, when it gets out of order the lamp must be returned to the maker. Further if the automatic feed be arranged for a certain strength of current, it cannot be used for other current strengths; finally it cannot be used for every experiment, for instance in obtaining emission spectra, during the production of which the resistance of the arc alters, for the reversal of the sodium lines etc.

On the other hand the mechanism of the hand feed lamp is extremely simple. The lamp may be used, within certain limits, with any chosen strength of current and it is suitable for all experiments. It is only necessary in regulating, to bring the carbons nearer to one another from time to time by a turn of the regulating screw. One soon becomes accustomed to this, so that it is effected almost mechanically. Our hand feed lamps may be used either with vertical or with sloping carbons so that the change from one position to another is effected extremely quickly. Three screws allow the arc to be displaced vertically and from side to side, as well as to move the two carbons towards one another. The lower carbon carrier has an attachment in which the revolving stand with 6 carbons for emission spectra may be placed, as shown in Figure 2195. The lamp is very substantial and accurately finished and is suitable for a current consumption of 10–20 amperes. For higher current strengths we construct a particular strong model No. 2196.



2195 with 2196.



2196.

Where sufficient means are available, we recommend our new Universal arc lamp which may be regulated by hand or automatically. This has been constructed so that the automatic regulating arrangement may be switched out by means of a handle and the lamp regulated by hand without disconnecting. Conversely the hand feed may be replaced by automatic feed in this lamp without the arc thereby becoming extinguished. This model is protected by D. R. G. M. 188758.

In order to use this arc lamp for all purposes we have in addition arranged that the arc may be used with direct or alternating current and have also provided an arrangement with revolving disc so that no further apparatus is necessary for emission spectra.

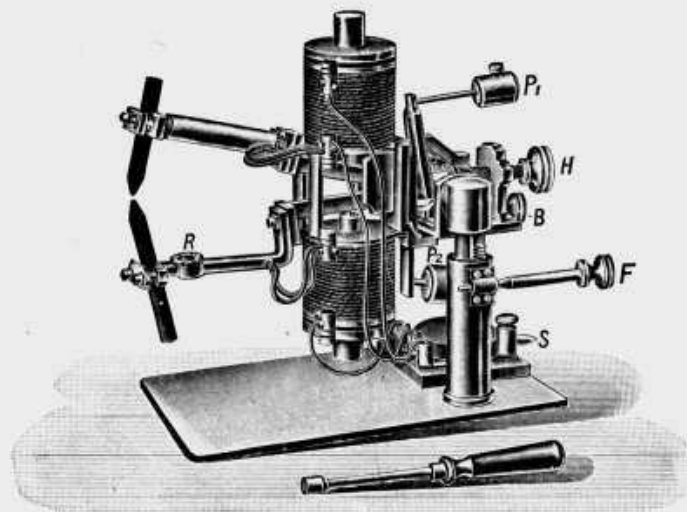
This new arc lamp uses, with both kinds of feed and with direct or alternating current, 10–15 amperes; the tension at the lamp amounts to 40 volts with direct current and 30 volts with alternating current.

The current is brought to two terminals and first passes a switch *S* which is either connected with the hand (*H*) or the automatic feed (*A*). If switched on *H* the current goes directly to the carbon holder. The screw *H* ends in front in a fork and the ends of the carbon holders prolonged backwards lie between. The screw *H* is screwed in and the arc can be regulated by means of it. If however the lamp is to be regulated automatically, the switch is connected with *A* and the screw *H* unscrewed. The current now passes from the switch to the two coils arranged over one another. An iron core is placed in each of these coils and connected with the upper or lower carbon holders; at the extreme ends the cores carry metal plates. With continuous current these iron cores are drawn into the coil if the arc be too short and thus the carbons are separated. With alternating current the two metal plates are repelled from the coils and the required lengthening in the arc takes place.

In order to unscrew or screw up *H* more quickly, a hook, not shown in figure, is pulled up with one finger and the screw moved with the other fingers in the desired direction.

Two sliding weights P_1 and P_2 allow of an automatic feed with a certain current strength and with the most suitable spark length. When these two weights are once adjusted, it is no longer necessary to make any alteration so long as the current remains the same.

The lower carbon is removable and at *B* a revolving disc with 6 hollowed out carbons for emission spectra may be fitted. The base of the revolving disc has an arrest contrivance for each of the six carbons, so that these set themselves exactly below the upper carbon and a particularly quick exchange is thus made possible.



2197.

The lamp is provided with a key to loosen or tighten up the screws for holding the carbons and thus new carbons may be put in even when the carbon holder is hot. Screw *F* is for raising or lowering the whole lamp, Screw *B* is for a side displacement of the point of light.

When using direct current the + pole is connected with the upper carbon. These upper carbons burn twice as quickly as the lower and are therefore correspondingly thicker. A crater is formed at the positive carbon from which the greatest light intensity proceeds. In order to promote the formation of a crater, the positive carbon is provided with a core of soft material. These carbons are called cored carbons, the ordinary negative carbons on the other hand, solid carbons.

In order to secure that as much light as possible will be taken up by the condenser, the carbons are inclined. With alternating current both carbons burn equally and therefore the carbons used are of equal thickness.

- 2195. **Hand feed lamp for direct or alternating current**, for currents up to 20 amperes; including 12 reserve carbons. [Fig. 1/5 nat. size.] \$ 25,00
 With order state whether the carbons are for direct or alternating current.
- 2196. — for current up to 50 amperes, special for cinematographs. [Fig. 1/5 nat. size.] » 25,00
- 2197. **Universal arc lamp for automatic and hand feed** with direct and alternating current. D. R. G. M. 188758. [Fig. 1/5 nat. size.] » 40,00
- 2201. **Revolving disc** wit 6 hollowed out carbons, suitable for lamps No. 2195 and 2197. » 3,75

Positive cored carbons for direct current lamps.

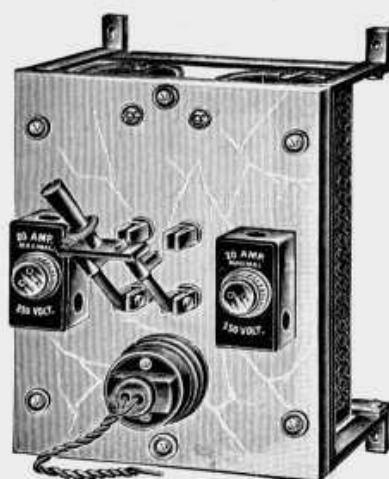
No.	2202.	2203.	2204.	2205.
for	8–10	10–15	15–25	25–40 amperes
Diameter	10	13	16	18 mm
Packets of 25 \$	0,30	0,40	0,60	0,75

Negative solid carbons for direct current lamps.

No.	2206.	2207.	2208.	2209.
for	8–10	10–15	15–25	25–40 amperes
Diameter	7	10	12	13 mm
Packets of 25 \$	0,15	0,30	0,35	0,40

Cored carbons for alternating current lamps.

No.	2210.	2211.	2212.
for	10–20	20–30	30–50 amperes
Diameter	10	13	18 mm
Packets of 25 \$	0,30	0,40	0,75



2222/2230.

Connection of the lamp with the lead.

A suitable resistance is necessary in connecting to a supply lead. The size of the resistance depends upon the voltage to be lowered (supply pressure about 40 volts) and on the current to be employed in the lamp. A resistance set made up of 1 or more single resistances is used for this purpose. These single resistances are mounted on a cast iron stand and provided with a removable cover, so that danger from heating is avoided. These resistances may be screwed on to the wall, it is however more advantageous to mount them behind a marble slab on the front of which are the necessary connecting screws, lead fuses, a switch and a wall plug. It is only necessary to screw this projecting slab fast to the wall and to connect the two cables of the supply lead with the terminals. After putting on the switch, the current required may be taken from the wall plug. The fuses protect the apparatus from too strong a current. The whole arrangement is in accord with the regulations of the «Verband Deutscher Elektrotechniker».

This switch board is completed by inserting an adjustable resistance with ammeter and voltmeter so that the current may be controlled at any time.

The resistances described as well as the switch board with resistances are exclusively for projection purposes and are to be employed only where a projection apparatus is to be put in circuit, as in halls, school rooms for scientific instruction etc.

When the current is to serve for experimental purposes as well as for projection, as in physical and chemical class rooms, this arrangement may be used for the projection apparatus and another switch board laid on for the experiments. We describe such switch arrangements p. 179.

Set of resistances for direct and alternating current, with removable cover, on cast iron stand, for 65 volt supply pressure.

	No. 2213.	2214.	2215.
current strength	10	15	20 amperes
	\$ 2,50	3,50	4,25

Set of resistances for 110 volt supply pressure.

	No. 2216.	2217.	2218.
current strength	10	15	20 amperes
	\$ 4,25	6,50	8,00

— for 220 volt supply pressure.

	No. 2219.	2220.	2221.
current strength	10	15	20 amperes
	\$ 12,50	17,50	23,75

— mounted behind a white polished marble slab, on the front face of which are placed, connection screws, lead fuses, switch and wall plug with 2 m double cable for 65 volt supply pressure. [Fig.]

	No. 2222.	2223.	2224.
current strength	10	15	20 amperes
	\$ 16,00	17,00	18,00

— for 110 volt supply pressure.

	No. 2225.	2226.	2227.
current strength	10	15	20 amperes
	\$ 18,00	21,25	22,50

— for 220 volt supply pressure.

	No. 2228.	2229.	2230.
current strength	10	15	20 amperes
	\$ 27,50	31,25	37,50

— like No. 2222/2230, but with adjustable resistance, ammeter and voltmeter for direct or alternating current (with order state the nature of current). For 65 volt supply pressure.

	No. 2231.	2232.	2233.
adjustable from	5–10	10–15	15–20 amperes
	\$ 40,00	42,50	45,00

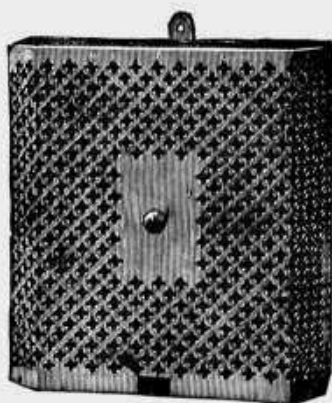
— for 110 volt supply pressure.

	No. 2234.	2235.	2236.
adjustable from	5–10	10–15	15–20 amperes
	\$ 45,00	47,50	50,00

— for 220 volt supply pressure.

	No. 2237.	2238.	2239.
adjustable from	5–10	10–15	15–20 amperes
	\$ 56,25	60,00	72,50

If an alternating current can be used, then instead of destroying the excess voltage by means of a resistance, a transformer may be employed. For example, an alternating current supply at 110 volts may be transformed down to 40 volts. If the arc consumes normally 10 amperes then $10 \times 40 = 400$ Watts are necessary for the lamp. The energy used up in the transformer amounts to about 50 Watts and therefore 450 Watts must be sent into the primary; the current flowing through the primary coil is $\frac{450}{110} = 4$ amperes.



2240/2245.

We supply these transformers for any ratio, in an enclosed casing, arranged so that it may be screwed on to the wall.

Transformer for alternating current, to connect with 110 volt supply pressure to work an arc lamp. [Fig.]

	No.	2240.	2241.	2242.
	of	10	15	20 amperes
	\$	14,00	15,00	16,25
— to connect to 220 volt.				
	No.	2243.	2244.	2245.
	of	10	15	20 amperes
	\$	14,50	16,00	17,50

c. Lime Light.

The method of producing lime light depends upon local circumstances. As is seen in table p. 113, the highest illuminating effect is obtained with compressed oxygen and compressed hydrogen, but for the sake of convenience, the oxygen only is usually compressed whilst coal gas is used in place of hydrogen. If the oxygen cylinder cannot conveniently be returned to the works for refilling, we recommend an arrangement which allows of the preparation of the two gases and of storing them in india rubber bags until the lecture. This arrangement requires time but possesses the advantage of cheapness.

Arrangement with compressed oxygen and compressed hydrogen.

The burner used is the so called mixed burner in which the gas is mixed in a special mixture chamber. The burners are provided with an arrangement for turning the lime cylinder from outside. A frame with mechanism for centring belongs to the burner which allows the point of light to be raised or moved sidewise.

When in use, the burner is connected to the gas cylinders by means of two india rubber tubes; the oxygen to the yellow the hydrogen to the black cock of the burner. In order to prevent the lime cylinder from cracking, it is recommended to warm the cylinder a little by allowing a small hydrogen flame to burn first of all for a few minutes and then to gradually turn on the oxygen.