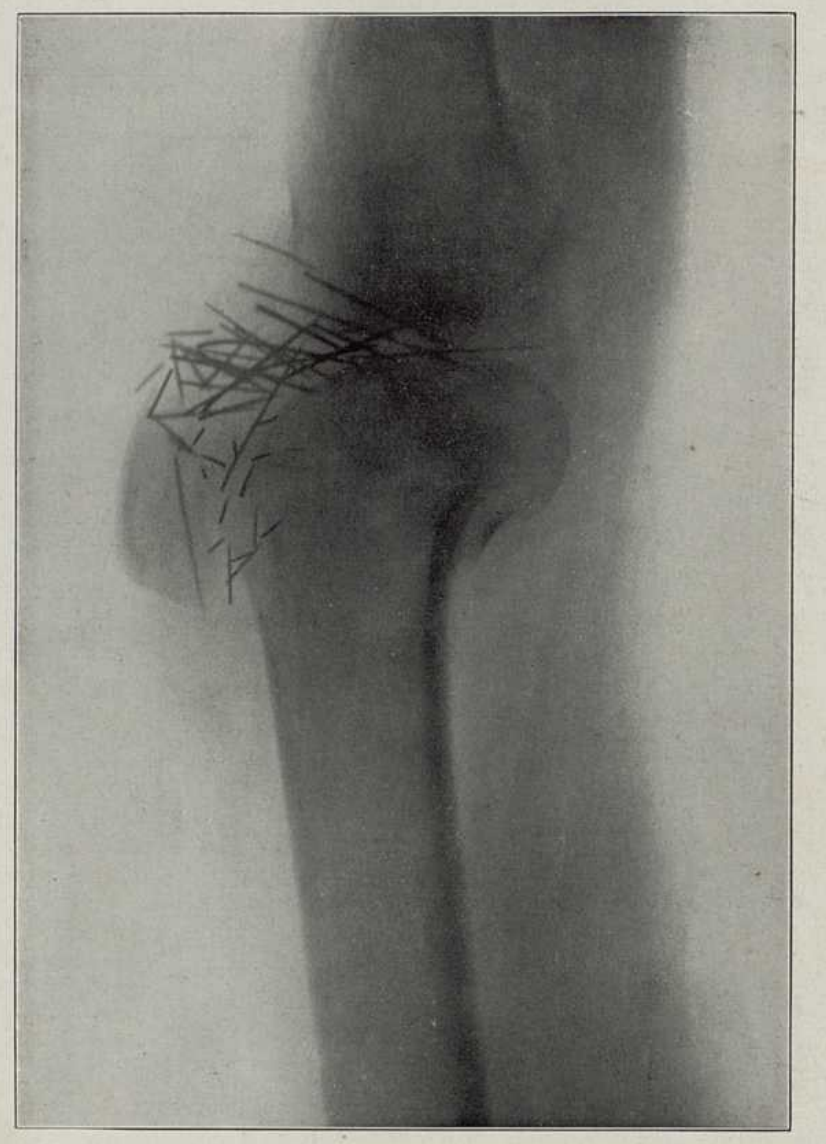
Table of Contents.

As a proof of the good results to be obtained from our apparatus, we would draw the attention of intending purchasers to the fact that in 1903 the Indian Government sent a special Officer home to select the most suitable X-Ray apparatus, both with regard to climate and efficiency. Apparatus manufactured by all the leading English, French and German Makers was experimented with, and we are proud to say that eventually we received the order to supply the apparatus.

Our Gold Medal Record Tube is the only X-Ray Tube that has been awarded a Gold Medal in England.

J. O. GRANT & TAYLOR,
ELECTRICAL ENGINEERS,
68, QUEEN VICTORIA STREET,
LONDON, E.C.



RADIOGRAPH BY C. THURSTON HOLLAND.

Adult—62 pieces of needle in and around knee joint.

10 in. Coil, Lumiere plate, 30 second exposure.

AMONG THOSE TO WHOM ....—

We have Supplied . . .

Complete X-Ray Outfits,

We may Mention:—

HIS MAJESTY THE KING, for the new Royal Yacht "Victoria & Albert."

The ADMIRALTY,
The WAR OFFICE,
The INDIA OFFICE,
The COLONIAL OFFICE,
The GENERAL POST OFFICE,
H.H. The MAHARAJAH OF TIPPERAH.

And the following Public Institutions:—

Accrington (Lancs.)—The Victoria Hospital.

Adelaide (Aust.)—The Children's Hospital.

Birmingham—The General Hospital, and the Birmingham and Midland Skin Hospital.

Bristol—The General Hospital.

Calcutta—The Mayo Native Hospital.

Cooper's Hill (Surrey)—The Royal Indian Engineering College.

Colchester—The General Hospital.

Delhi (India)—The Civil Hospital.

Dundee—University College, and the Royal Infirmary.

East London (S. Africa)—The Frere Hospital.

Edinburgh—The Royal Infirmary.

Glasgow—The Royal Infirmary.

Golspie (Sutherland)—The Lawson Memorial Hospital.

Hemel Hempstead—The West Herts Infirmary.

Hull—The Royal Infirmary.

Ipswich—The General Hospital.

Launceston (Tasmania)—The General Hospital.

Leeds—The General Infirmary.

Liverpool—University College, New Cancer Research Laboratory, and Parish Infirmary.

London—King's College Hospital, the Middlesex Hospital, University College Hospital, the Cancer Hospital, the Fever Hospital, the Victoria Hospital for Children, the West End Hospital, the Evelina Hospital, the Bolingbroke Hospital, the Mount Vernon Hospital for Consumption, and the Birkbeck Institute.

Lowestoft—The Lowestoft Hospital.

Luton (Beds.)—The Bute Hospital.

Melbourne—The Children's Hospital, and the General Hospital.

Multan (India)—The Military Hospital

Newport (Mon.)—The Newport Infirmary.

Nottingham—The General Hospital.

Portsmouth—The Royal Hospital.

Rotherham (Yorks.)—The General Hospital.

Rochester—St. Bartholomew's Hospital.

Sevenoaks—The Children's Hospital.

Sheffield—The Royal Infirmary.

Shrewsbury—The Salop Infirmary.

Southampton—The Royal South Hants. Hospital.

Stockport (Cheshire)—The Stockport Infirmary.

West Bromwich (Staff.)—The West Bromwich Infirmary.

Waterford—The City & County Hospital.

Wolverhampton—The General Hospital.

Worcester—The General Hospital.

York—The County Hospital.

Some Opinions on our Apparatus generally.

The General Infirmary, Worcester:—"The apparatus is working well."

The Bristol Infirmary:—"The apparatus works well, and is very satisfactory in every way."

JOHN R. WILLIAMS, Esq., M.B., C.M., Penmaenmawr, North Wales:—"The X-Rays are acting splendidly."

J. HALL EDWARDS, Esq., L.R.C.P. & L.M., the well-known X-Ray worker, of Birmingham:—"The show was a complete success, and the apparatus worked splendidly."

S. W. writes from East Sheen:—"The new Coil and Tube work splendidly, and I have taken some excellent radios therewith."

A. W. G. E., Earlswood, Surrey:—"I am doing very well with the X-Ray set I had from you; the Coil works splendidly, in fact, the whole set has given me great satisfaction."

Rev. F. W. WALTER, Eastleigh, Hants:—"I had the pleasure of using your splendid X-Ray instruments at Hurstbourne, last Tuesday. They gave the most perfect satisfaction, the ribs and heart being seen with the greatest ease."

N. A., M.B., D.P.H., etc., writes from Southampton:—"I am glad to inform you that the Coil, Tubes, etc., purchased from you last Spring have given me complete satisfaction, and I have obtained better results with them than with any other apparatus I have used."

Mr. E. H. HOWLETT, F.R.C.S. & L.R.C.P., writes from Hull:—"The break has arrived, and works absolutely perfectly; if it will only last without the glass cracking. *Re* Infirmary Coil, I have been trying it to-night with the Wehnelt, and it works very well; not equal to my Coil, but then it is not so big. You have done the work very well indeed."

PETRIE HOYLE, M.D., 706 Sutter Street, San Francisco, U.S.A.:—"My X-Ray works very well, and has been thought by several to give very fine definition. I am very glad I got it, my only regret being that I did not get the new sort of batteries that give 42 amperes to the 12 volts. I am also sorry that I did not get one of your localisers."

From Mr. W. H. FOWLER, Pharmaceutical Chemist, Redhill, Surrey:—"The whole apparatus has had many severe tests in transport, but with all this it is as good as the day I had it from you. Our results have been most satisfactory, and Doctors and others who have seen it at work have expressed themselves most pleased with the whole apparatus."

Induction Coils.

COX'S HEAVY DISCHARGE INDUCTION COILS.

GENERAL REMARKS.

OUR Coils are manufactured throughout in our own workshops by English workmen, the materials used being of the best quality procurable, and the workmanship and general finish unrivalled.

They are the result of hundreds of experiments which have been conducted almost daily at our works during the past six years. These experiments and tests have been based upon scientific principles, coupled with an intimate practical knowledge of electricity, the result being that our Coils are of the highest efficiency, give the best results, and may be regarded as **the most perfect Coils in the market for radiography, screen-work, and high frequency treatment.**

WINDING. — We claim that our system of winding in two sections, is far superior to the many-section system usually adopted, for not only are our two-section Coils less liable to break down and more easily repaired, but, by avoiding the unnecessary insulation of numerous sections, *the spark produced is white and rich, while that produced by the many-section Coil is thin and blue.*

As this has been denied, *we invite Practitioners to compare the results given by one of our 10-inch spark two-section Coils with those obtained from any 10-inch multi-sectional Coil, no matter who the maker may be.*

Moreover, it will be found that all our Coils give a longer spark than that which we profess them to give; for instance, our 10-inch spark Coil will give from 11 to 12 inches, and so on.

We can, of course, construct Coils with any number of sections, if desired, but do not recommend multi-sectional coils.

CONDENSERS.—These are of special make, being the result of careful investigation and tests.

INSULATION.—Our insulating composition is specially prepared to withstand heat, the melting point being considerably higher than that of the wax ordinarily used. Moreover, for use in India and Tropical climates, we are making Coils with special insulation, which have been subjected to a temperature of over 130° Fahr. for 10½ hours, in a Turkish Bath, without being affected in the least degree.

DISCHARGING PILLARS.—These are all fitted with ball sockets.

INTERRUPTORS.—Coils always give better results when worked from a motor mercury or electrolytic interruptor, but as these are not always available—and to provide against their possible failure—we advise intending purchasers to avoid all Coils not fitted with an oscillating contact-breaker. Except for special work, or where otherwise ordered, we fit all our Coils with what we consider the best form of oscillating platinum contact interruptor (see p. 18), with extra terminals for connecting electrolytic or other interruptors, as may be desired. All Coils, from 6 inch up to 14 inch spark, have stout ¼ inch platinum contacts.

Our Coils may be worked either from accumulators or (with a suitable resistance) from the *direct* current supply mains; we find, however, that accumulators give slightly better results.

The size of Coil chiefly in demand for X-Ray and High Frequency work is that giving a 10 inch or 12 inch spark (marked * in Price-list), as with either of these, used in conjunction with our Fluorescent Screen, the spine, ribs, heart, etc., can be readily discerned, and radiographs of the ribs and pelvis can be taken *with an exposure of about 15 seconds.*

Each apparatus before leaving our works is subjected to severe tests, and *we guarantee every Coil against breaking down* under fair treatment.

Coils from 6 inches to 12 inches spark can generally be delivered from stock. Special orders are in most cases executed within ten days. Customers can call and see their Coils in course of construction.

"THE LANCET," of August 13th, 1898, in an article upon the Meeting of the British Medical Association at Edinburgh, says:—

"Mr. HARRY COX, of 10 and 28, Cursitor Street, Chancery Lane, exhibited his well-known effective X-Ray outfit, including several powerful Coils of exclusively English make, and improved Fluorescent Screens. He demonstrated also a means of intensifying the X-Ray negative. On the stall were some of the best X-Rays photographs we have seen. Mr. Cox personally superintends the winding and insulation of his Induction Coils, with very satisfactory results. Moreover, they are moderate in price, and give a maximum spark-length with a minimum of battery power."

Cox's Heavy Discharge Base Coil.

As Supplied to H.M.'s Government and the Leading London and Colonial Hospitals and X-Ray Workers.

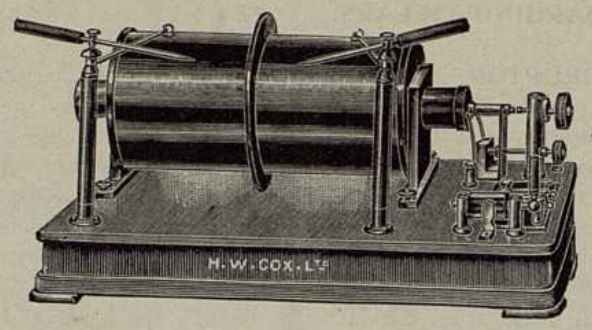


FIG. 1.

PRICES FOR STANDARD SIZES.

No. **1**,	giving a	4 in.	Continuous	Spark	...	...	each	**£10**	**0**	**0**
„ **2**,	„	6 „	„	„	...	...	„	**14**	**0**	**0**
„ **3**,	„	8 „	„	„	...	...	„	**20**	**0**	**0**
*„ **4**,	„	10 „	„	„	...	...	„	**25**	**0**	**0**
*„ **5**,	„	12 „	„	„	...	...	„	**30**	**0**	**0**
„ **6**,	„	14 „	„	„	...	...	„	**34**	**0**	**0**
„ **7**,	„	18 „	„	„	...	...	„	**70**	**0**	**0**

Special Quotations for larger sizes.

The above prices include Condensers, Double Discharging Pillars, and Special Contact Breaker fitted with stout Platinums

For instructions, see Appendices I. and II.

These Coils are of the finest workmanship and finish, and of the highest efficiency.

Some of the leading Hospitals and X-Ray Workers have had our Base Coils, of the above pattern, in use for upwards of 6 years, and report to us that they are still giving highly satisfactory results.

With any of the above-mentioned sizes, except Nos. 1 and 2, used in conjunction with our Fluorescent Screens (see p. 33), the spine, ribs, and liver in the human body, as well as the movements of the heart and diaphragm, can be plainly discerned. Refer to the Appendix for working directions.

Testimonials.

From the Royal Naval Hospital, Simonstown, Cape Colony:—"The New Coil works very well."

Messrs. A. G. FRYETT, F.R.M.S., & F. D. BIRD, M.S., F.R.C.S., of Melbourne, Australia, write:—"The Coil continues to give entire satisfaction, and we are more pleased with it every day."

Dr. J. MacINTYRE, Glasgow, &c., Ex-President of the Roentgen Society, writes from Glasgow:—"I have shown the Coil to several of my friends, who are more than pleased with it."

A Doctor writes from South Africa:—"I have done excellent work out here, and your Coil is all that one could wish for."

From Mr. ALFRED L. STENT, Hon. Radiographer, Emsworth Hospital, Havant:—"I am very pleased with the 10 inch Coil which I had from you. I have tried numerous Coils, but never had one work so well as yours."

R. B. writes from Kilkenny:—"Do you supply 3 to 4 inch spark Coils? If so, let me know price—but it must be your own make. Your 9 inch spark Coil is giving satisfaction."

Dr. DAVID WALSH, M.D., the well-known X-Ray worker, and author of "The Röntgen Rays in Medical Work":—"The 10 inch Coil supplied by you has given me entire satisfaction. It has been in active use for more than twelve months' so that I have had ample opportunity of testing its capabilities."

From Mr. R. S. CLAY, of the Birkbeck Institution:—"I am much pleased with the Coil which you supplied to us; and after two years' experience with it, am glad to inform you that it has never given the slightest trouble. I think it a very cheap instrument, being both in performance and workmanship quite as good as others at nearly double the price."

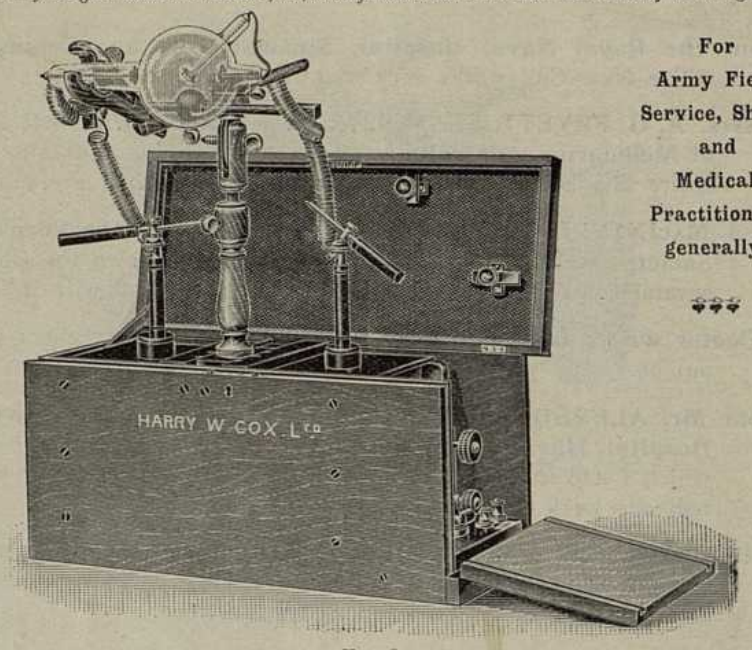
Mr. HENRY BALL, Radiographer to the Southport Infirmary, writes, that he has found our Coils and Tubes satisfactory in every way; "particularly is this the case with the 12 inch spark Coil I had from you a month ago. With it I have radiographed the spine of an adult in the space of three minutes."

From Mr. J. WILLIAMSON, Photographic Chemist, Hove, Sussex:—"I want to return you my Coil, to add a new contact breaker. I may say that I have had it in pretty constant use for X-Ray work ever since I had it two years ago, and judging by the results, I would not exchange it for any other I have seen."

COX'S IMPROVED

Heavy Discharge Portable Coil.

(Specially designed and constructed by us, in conjunction with Mr. Hall Edwards of Birmingham.)



For Army Field Service, Ships, and Medical Practitioners generally.

FIG. 2.
Diagram showing Coil fitted with Localising, or Stereoscopic Slide.

PRICES FOR STANDARD SIZES.

Giving a 8 inch Continuous Spark...	...	...	...	£22	0	0
„ 10 „ „ „ ...	...	...	...	30	0	0
„ 12 „ „ „ ...	...	...	...	34	0	0

N.B.—These prices do not include the Localising Slide, the price of which is £2 10s. 0d. extra.

*****

WE were the pioneers of Portable Outfits, and although many professional men continue to give preference to the ordinary form of Coil, we venture to predict that the portable pattern will eventually come into most favour, for the following reasons:—

The Portable Coil, if properly constructed, is in every respect as powerful and effective as the other. The proviso is necessary, because, as our experiments have proved, if the casing be not carefully constructed, and of suitable materials, a leakage of current will inevitably result. It is also possible to overstep the limits to which the size and weight of the Coil may be safely reduced. Our Portable Coils are made as light and compact as practicable, without impairing their efficiency, and we invite X-Ray workers to compare by test, the power of these Coils with that of any other Coils in the market, of equal spark-gap.

Our Portable Outfit justifies its appellation. It can be readily carried from place to place by a medical man in his brougham or dog-cart, and used at the patient's bedside. When not in use, the apparatus is completely protected from dust. To veterinary surgeons it should prove specially serviceable.

These Coils are fitted with our improved Oscillating Platinum Contact Breaker, and with ¼-inch Platinum Contacts, and provided with separate terminals for working with mercury, or electrolytic interruptors.

The ball-socket discharging pillars fit into the tops of the Coil by means of plugs, and when not in use are carried in clips inside the cover of the box. The latter is made of the best seasoned mahogany, and the entire apparatus is of the finest English workmanship and finish throughout, and a model of compactness.

N.B.—These Coils, if fitted with our new localising or stereoscopic slide, invented by Mr. Cox (see FIG. 2*), will, in conjunction with our new plate-changing box (see* FIG. 29*), enable the operator to take stereoscopic skiagraphs.*

We also supply, when required, a strong deal-wood case for the protection of the handsome mahogany box when travelling. Price, including strap, **21s. 0d.**

We would again impress upon customers that these Coils are as effective as those illustrated by FIG. 1, but are more compact and portable.

We have had the honour of supplying a Coil of the pattern shown in Fig. 2, for His Majesty's new Royal Yacht "Victoria and Albert."

And to the following:—

The Admiralty, for use on Battleships, &c.
The War Office, for use in South Africa, China, and Somaliland
The Hospital Ships "Princess of Wales," "Maine," "Spartan," "Trojan," and "Jelunga."
The Deep Sea Hospital Ship "Alpha."
The Royal Victoria Hospital, Netley.
The Cambridge and Connaught Hospitals, Aldershot.
The National Scottish Red Cross Hospital.
The Welsh Hospital.
The Imperial Yeomanry Hospital.
And the Royal Naval Hospitals at:—

Haslar,	Sheerness Dockyard,	Pembroke,
Haulbowline,	Dartmouth,	Yokohama,
Deal,	Shotley,	Jamaica, Bermuda,
Portland,	Harwich,	Esquimault, &c.

Cox's
New Variable Primary Coil.

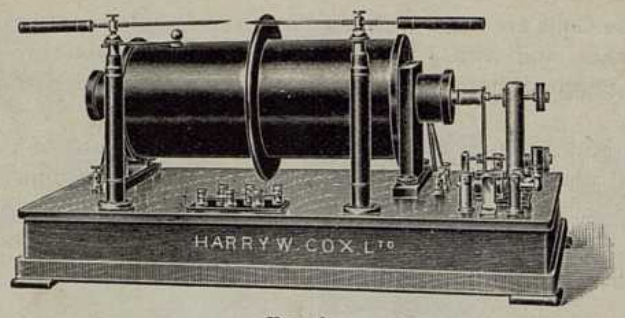


FIG. 3.

PRICES FOR STANDARD SIZES.

No. 13— 4 in. spark...	£13	0	0	No. 17—12 in. spark...	£33	0	0
„ 14— 6 in. „ ...	17	0	0	„ 18—14 in. „ ...	37	0	0
„ 15— 8 in. „ ...	23	0	0	„ 19—18 in. „ ...	73	0	0
„ 16—10 in. „ ...	28	0	0				

This Coil has been specially designed, and is so constructed that the primary can be connected in ten different ways, thus enabling the operator to select whichever method gives him the best results, according to the Interruptor and the current employed. It is fitted with a Condenser and Platinum Contact-breaker, and is in every respect similar to Fig 1, with the exception of the primary, as stated above.

For instructions, see Appendix III.

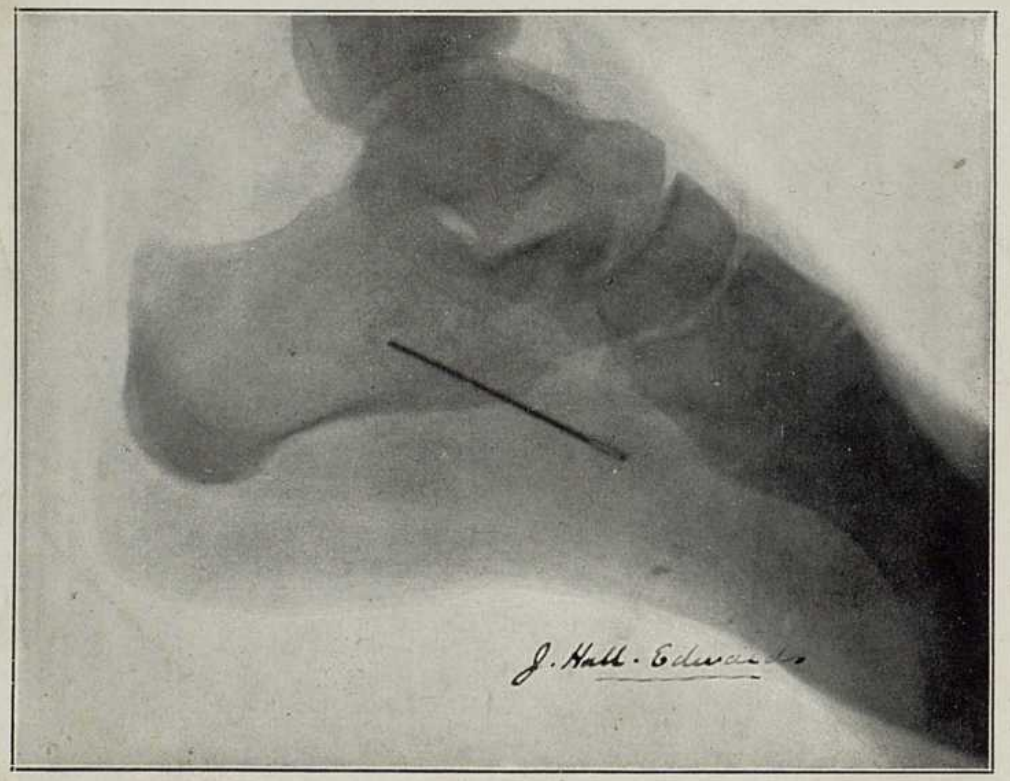
Cox's
Interchangeable Primary Coil.

Specially Constructed for working with the Electrolytic Break.

PRICES FOR STANDARD SIZES.

No. 8— 8 in. spark...	£14	0	0	No. 11—14 in. spark...	£30	15	0
„ 9—10 in. „ ...	20	0	0	„ 12—18 in. „ ...	48	0	0
„ 10—12 in. „ ...	23	0	0				

N.B.—These prices do not include any Contact Breaker, or Condenser, which are unnecessary for work with the Electrolytic Break.



Interruptors, or Contact Breakers.

Interruptors, or Contact Breakers.

GENERAL REMARKS.

THE functions of the Contact Breaker are briefly described in our "Practical Hints to Beginners" (see p. 81), and as already explained, we make a practice, except in special cases, of fitting to every Coil a Cox's Vibrating Contact Breaker, with ¼-inch platinum points, the working of which is fully explained therein.

Useful, however, as these Platinum Breaks are, and undesirable as it is to have a Coil without them, few X-Ray workers are content to depend entirely upon them when such far finer results can be obtained by means of the various forms of Motor Mercury, and Electrolytic Breaks which we manufacture.

In this section these improved Interruptors are described as clearly as the space will allow. We shall be glad to show any of them in action at our works to intending buyers.

Testimonials.

LAURENCE C. PANTING, M.A., M.D., &c., writes from Truro, Cornwall:—"Allow me to thank you for the Break and Tube which I received uninjured, and also for the Mercury, which, however, I do not require, as I already had sufficient. I will return it in a day or two. I have tried the Tube and Break and am so far very much pleased with the results. I have been using 16 volts on the Break with 24 on the Coil, but I find that I get better results when using only a little under 5 lbs. of mercury, as with the full amount, 6½ lbs., I get too large a current when not using any resistance on the circuit."

EDWARD J. WATSON, B.A., M.D., &c., writes from Dublin:—"I have waited to answer your letter until to-day in order that I might give the new Break a trial. A greater contrast between this one and * * * cannot be imagined. So far I think this Break is perfect and all that can be desired. With 18 or 24 volts, 6 is not enough for the motor, but working with 18 or 24 volts and taking the motor current from the same battery, it is splendid."

Mr. W. J. FOSTER, F.R.C.S., of Reading, writes:—"I have got over the difficulty with the Hospital apparatus, by having one of your new M.D. Breaks. I intend bringing that home and trying if that is better than the old one. It has just put the Hospital apparatus right. We can do anything with it, and all the old useless tubes work like new ones."

Mr. E. H. HOWLETT, writes from Hull, Yorks.:—"I am absolutely satisfied with the Electrolytic Break. It is perfect in every way, and just as good as when you sent it to me."

G. R. C. writes:—"Your new form of Break is a great success. I have had several other designs, but none of them would work properly on the 240 volt electric main. They would either stop altogether, or the glass tube would become heated and break. I have had none of these difficulties with the new pattern. It has worked without trouble from the first time of using it."

The Mackenzie-Davidson Patent Motor Mercury Break.

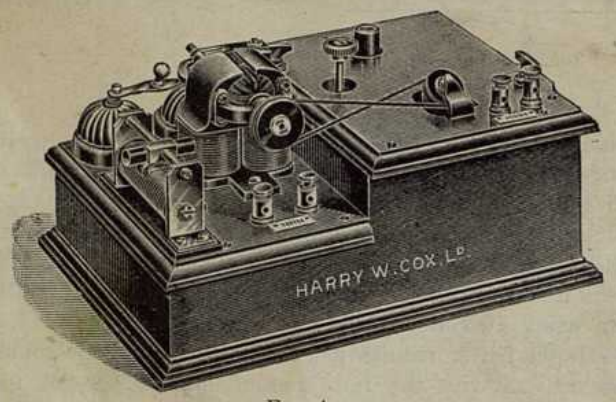


Fig. 4.

PRICES.

Including Switch for starting the Motor, and Rheostat	£6 16 6
Six pounds of **Mercury** at 3s. 6d. per pound	1 1 0

FOR a description of how to work this well-known Interruptor, which is the invention of J. Mackenzie-Davidson, Esq., M.B. & C.M., who has given us the sole manufacturing rights, see Appendix IV.

The Break is thoroughly well made and finished throughout. The motor is of an improved type, and is self-starting. The terminals for connecting to the Coil and accumulators respectively, are clearly labelled, so that a mistake can hardly occur; and there is no difficulty in attaching this Interruptor to any Coil in a few moments.

Unless otherwise ordered, we send out the above Break fitted with a 12 volt motor, which can either be driven from a separate 12 volt accumulator, or as a "shunt" from the battery which works the Coil.

If it is desired to drive the *motor* from the *direct* current electric light mains not exceeding 100 volts, it will require to be specially wound, for which we make an extra charge of **£1 0 0.** If more than 100 volts are used, a lamp resistance will be needed.

For use with Coils not fitted with terminals for connecting the mercury Break we supply a Connector, a simple contrivance for insertion between the platinum points of the vibrating Contact Breakers. Price, 3s. 0d.

This Break is equally efficient for X-Ray or High Frequency work.

Dr. MacIntyre's New Motor Mercury Dip Interruptor.

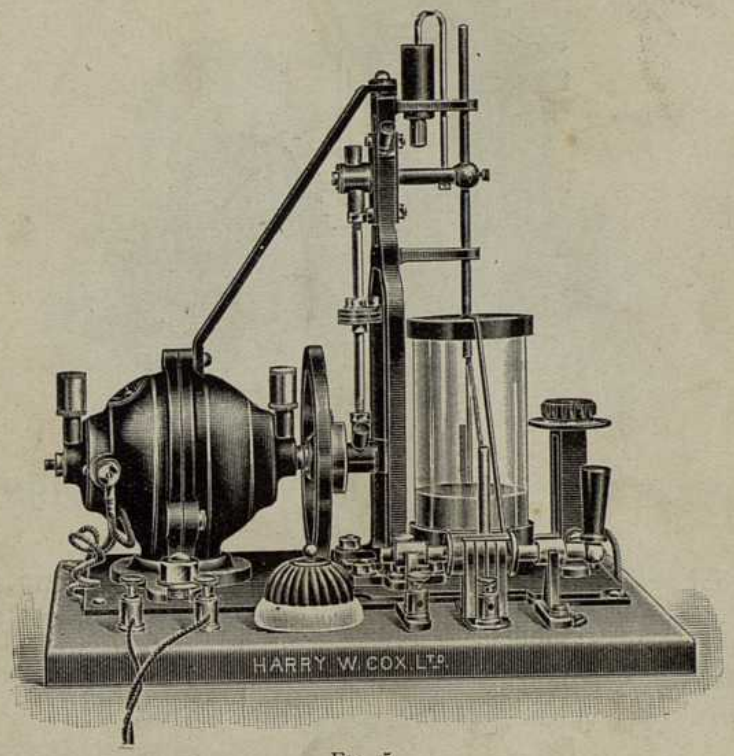


Fig. 5.

PRICE ON APPLICATION.

This has been specially designed by Dr. J. MacIntyre, F.R.S.E., Ex-President of the Roentgen Society. It is constructed in a substantial manner to stand rough work. The motor is of an improved type, can be made to work direct from the mains, and can be connected to any Coil.

Motor Mercury

Jet Interruptor.

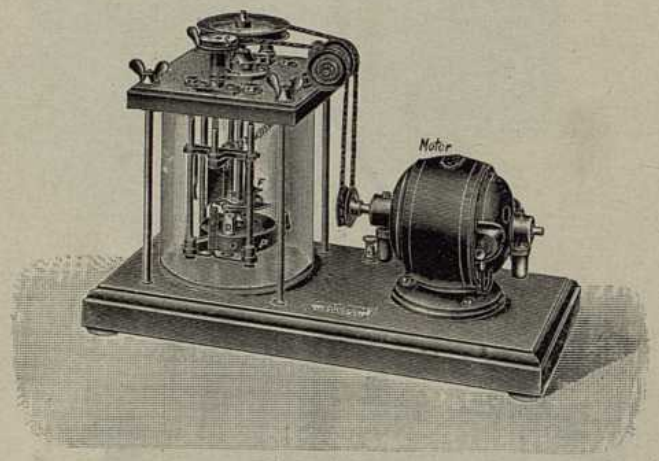


Fig. 6.

PRICES.

For any voltage up to 100	£10 10 0
For voltages above 100 and up to 250	11 11 0

The above Prices do not include Mercury.

The Break is connected and used in a similar manner to the Mackenzie-Davidson. Instead of a revolving blade which dips into the mercury, a jet of mercury is forced against revolving blades of copper, thus making and breaking contact.

It is a very efficient Break, and can be adjusted for any number of interruptions from 100 to 50,000 per minute.

It can be worked from any *direct* current supply mains up to 250 volts. The mercury is covered with alcohol or paraffin.

Motor Interruptor,

without Mercury.

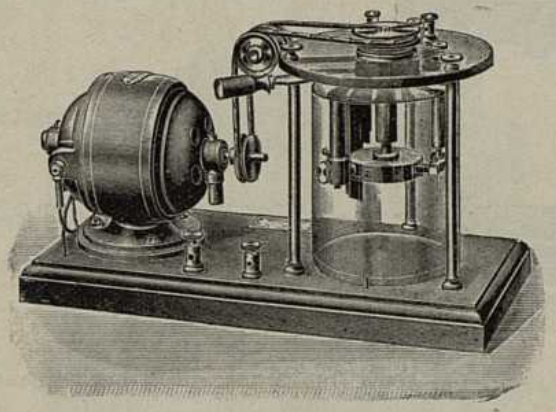


Fig. 7.

PRICE **£10 10 0**

In this Break the interruptions are effected by means of a motor, which revolves copper segments. The latter, in rotating, press against two contact brushes, thus making and breaking contact. The whole is immersed in alcohol or paraffin.

RHEOSTATS,

to control the speed of the motor (Figs. 4, 5, 6, & 7).

For 12 volts	£0 17 6
„ 100 „	1 5 0
„ 200 „	2 0 0

COX'S

Improved Electrolytic Interruptor.

Fig. 8.

PRICES.

	£	s.	d.
No. 1, with 2 Platinum Electrodes	2	10	0
No. 2, ,, 3 ,, ,,	3	0	0
No. 3, ,, 4 ,, ,,	3	10	0
Cox's Special **Cooler,** with 12 feet of rubber tubing	0	12	0

Of the above we find that No. 1 is generally used.

We claim for the above Interruptor the following advantages:—

The current can be regulated.

It does not, like most Electrolytic Breaks, stop when heated.

The Tube runs absolutely steadily, and the Break will make nearly 2,000 interruptions per second according to the voltage used.

It gives excellent results with the High Frequency Apparatus (Fig. 73), when worked with from 36 to 50 volts.

It can be worked from the *direct* current mains, either with or without a rheostat in the circuit. We find that a rheostat gives the operator greater control.

With high voltage current this Break can be used in series with the mercury Interruptor, in which case the platinum points of the vibrating contact Break must be separated by means of a piece of cork, or other insulating material. This method, which was originally suggested by Dr. MacIntyre, will be found to work well for X-Ray work.

In similar manner two Electrolytic Breaks may be connected in series, with high voltage currents, the effect being to increase the spark length with less current. For instructions see Appendix V.

Valve Tube.

For use with the above, in series, with any focus tube. The life of the focus tube is preserved, and better results are obtained.

COX'S . . .

Caldwell Swinton Electrolytic Interruptor.

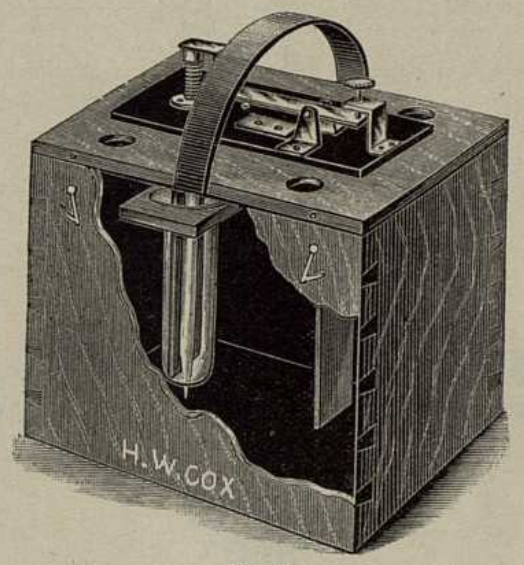


Fig. 9.

PRICE complete .... £3 0 0.

The above Interruptor can be worked off the alternating or direct current mains, and is the outcome of experiments of Caldwell Swinton and others. We have specially designed the regulating parts so that it is easy to manipulate, and the current is quite under control from a 100 to 200 volts circuit. Both of the Electrodes are of the same metal, the current passing from one plate to the other through a small hole at the bottom of a glass vessel, in which is one of the Electrodes. The current is regulated by the Screw at the top of the Interruptor, which raises or lowers the glass rod, which is tapered, and passes through the hole at the bottom in the glass vessel. It is fitted in a polished, dovetailed, lead-lined box. The Electrolyte is dilute sulphuric acid, about one in ten for 100-volt circuit and weaker for higher voltages.

X-Ray Tubes.

X-RAY . .

FOCUS TUBES.

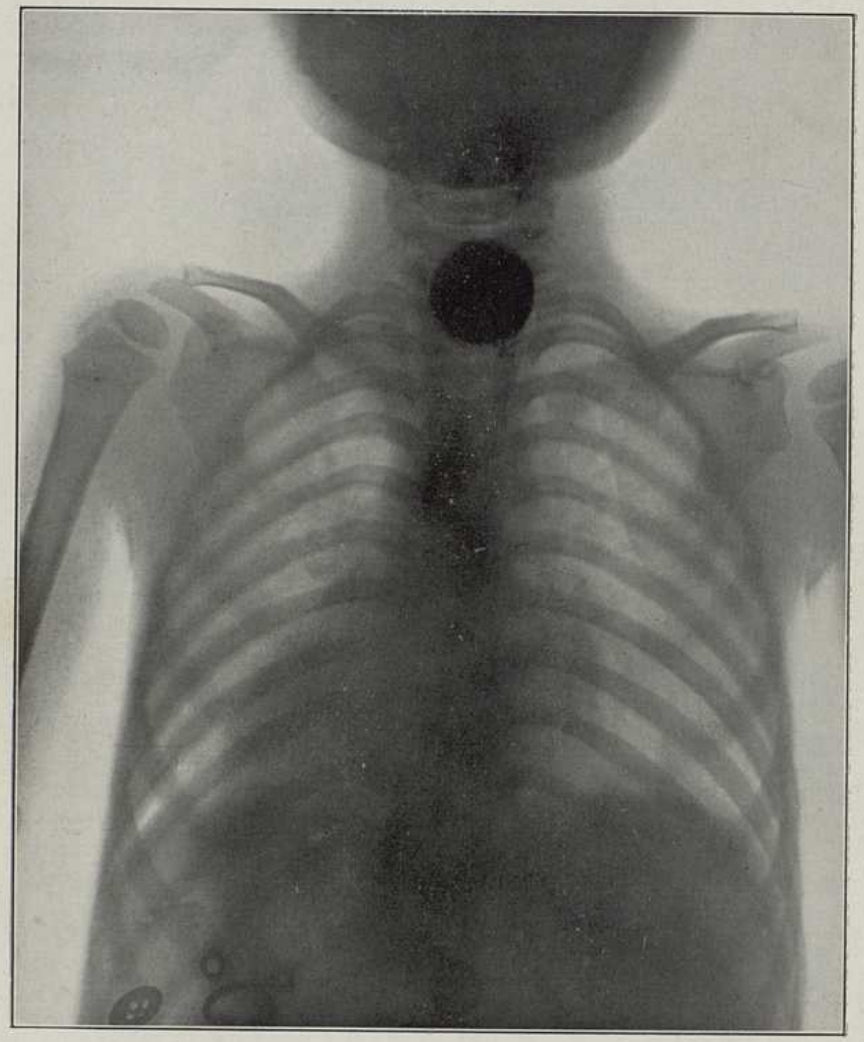
GENERAL REMARKS.

FULL information as to X-Ray Tubes and their use will be found in our "Hints to Beginners," pp. 83-96, where we have explained that the essentials of a good Tube are :—

1. Durability,
2. Definition,
3. Penetration.

We have always made it our special object to provide customers with Tubes which may be relied on for these three qualities. Whether we have succeeded or not may be gathered from the appended examples of many unsolicited testimonials which we have received.

There is a great number of Tubes of various kinds on the market, and we are constantly receiving samples for which the makers claim some special advantage. Anxious as we are to secure the best possible apparatus, we submit all such samples to fair tests, but we offer for sale only those which come up to our standard, which we know to be the best for screen work, radiography, or therapeutic treatment, as the case may be.



RADIOGRAPH BY C. THURSTON HOLLAND, LIVERPOOL.

Child 5 years old—Coin in œsophagus.

10 in. Coil, 15 seconds exposure.

Testimonials. . .

The following are a few extracts from business letters which we have received referring to our Tubes:—

Mr. J. MACKENZIE-DAVIDSON, M.B. & C.M., writes from Portland Place, W.:—"I am well pleased with the two 'Record' Tubes you sent to Charing Cross Hospital. Please to send another two similar ones to me here."

A Doctor writes from Dingwall, Ross-shire, N.B.:—"Surely your Tubes give a much greater range than the usual run."

From a Gentleman at Walmer:—"I tried the Tube last night, and find it works excellently. I tried my next best tube in the same way, and yours beat it out and out. It would have required certainly double the exposure to equal yours, and even then I doubt if the definition would have been so good."

A Doctor writes from Penrith:—"The X-Ray Tube, etc., reached me safely, and I am much pleased with the goods."

Mr. W. D. JEFFERSON, L.R.C.P., L.M., & M.R.C.S., writes from Ripon, Yorks.:—"I like the Tube very much, and return 6d. in stamps."

From the Norfolk and Norwich Hospital:—"I am sending you a pair of platinum-faced interruptors from the induction Coil in the X-Ray room here, for repair. I will send official order on hearing from you. I may say that the 'Record' Tube you left me has given great satisfaction to us."

From an Electrical Firm in Glasgow:—"We beg to acknowledge receipt of six of your X-Ray Tubes. We are much pleased with these, and intend keeping four of them instead of two, as originally ordered. We are returning you herewith the remaining two."

From the West Kent Hospital, Maidstone:—"The two 'Record' Tubes you sent on approval to the West Kent Hospital are excellent. We are going to keep them."

From the Royal Infirmary, Glasgow:—"Enclosed please find official order for four X-Ray Tubes. The last five supplied by you were in every way satisfactory, and I trust these will turn out as well. I require two of them for use with a Mercury interruptor, and two for the Wehnelt."

Mr. S——, Sheerness, telegraphs:—"First attempt with your Tube gives perfect result."

Dr. M. M. SHARPE, L.R.C.P., L.R.C.S., & L.F.P.S., writes from Beaumont Street, Portland Place:—"Your Tube is still working beautifully."

From Mr. W. WILLIS, Bromley, Kent:—"The Tubes you kindly sent me are most excellent. I enclose cheque for £7 15s. 0d. in payment."

Mr. T. CLARK writes from Bristol:—"Your Tube arrived quite safe. I am very pleased with it. The detail is very good indeed, much better than from more expensive Tubes I have in my possession. I enclose postal order for 19s. 6d."

COX'S

Gold Medal "Record" Tube.

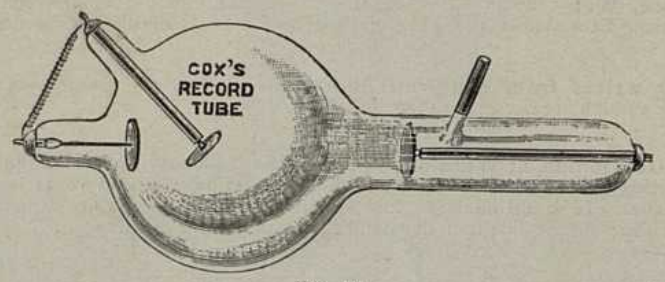


FIG. 10

PRICE ... £0 18 6 each.

For all ordinary X-Ray work the above Tube is without a rival. It gives good definition and contrast, and is also excellent for therapeutic work.

It was selected in 1901, by the committee specially appointed by the Roentgen Society out of many competitors, for the Gold Medal given by Dr. MacIntyre, then President of that Society. It has in the meanwhile maintained its lead, and the demand for it continues to increase.

Many of the leading X-Ray workers regularly send us repeat orders for as many as half-a-dozen Tubes at a time.

N.B.—We can supply Figs. 10 and 11 with a small piece of Iridium fitted to the centre of the Anode, at an additional charge of 10s. Iridium withstands heat better than Platinum, but is more costly.

A Recent Testimonial.

From one of the Radiographers R.A.M.C., dated 10th September, 1903:—"I used your Tubes in S.A. for 2½ years. Some of them I used for 4 or 5 cases a day, for 8 or 9 months, and they were still good."

COX'S

"Record" Regulating Tube.

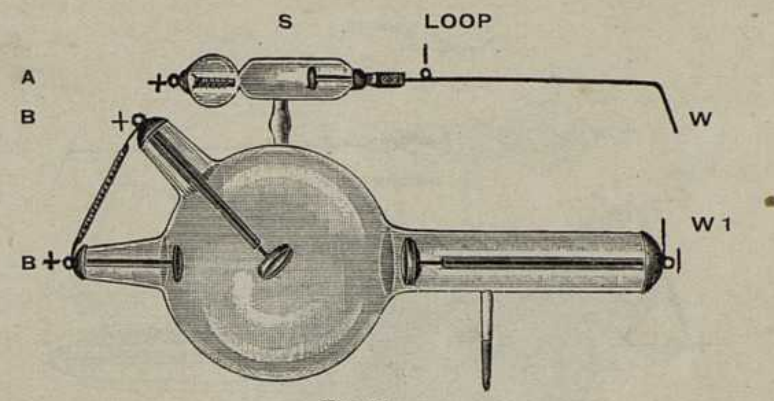


FIG. 11.

PRICE ... ... £1 11 6 each.

This Tube has been designed so that almost any degree of hardness can be obtained. It may be connected with the discharging pillars of the Coil in the usual way, at B+ and W1, and worked in this manner so long as the resistance is satisfactory, and the definition desired is obtained.

If the vacuum becomes too high, and the resistance consequently too hard, the adjustable spark-point W. (which is connected with the cathode of the auxiliary tube) is swung round to within half-an-inch of W1, and the current turned on for a few seconds. The effect will be to drive a minute quantity of gas out of the auxiliary into the main tube, and thus to lower the vacuum in the latter. Work would then be resumed with the spark-point in its normal position. In the event of the resistance becoming excessive, sparks would pass from W. to W1, thus, to some extent, making the regulating automatic. A more drastic means of overcoming the resistance is by removing the connecting wire from the cathode terminal W1, and fastening it to the loop marked I. In this case, however, care must be taken not to use too strong a current, or the tube will be made too soft.

If, on the other hand, it is desired to increase the resistance, then the spark-point must be swung as far as possible from W1, and the connecting wire must be removed from B+ of the main tube to A+ of the auxiliary tube—the other wire being connected with W1—and the current turned on for a few seconds. The discharge which now takes place increases the vacuum, and the connection with B+ may be resumed.

Cox's "Record" . . Heavy Anode Regulating Tube.

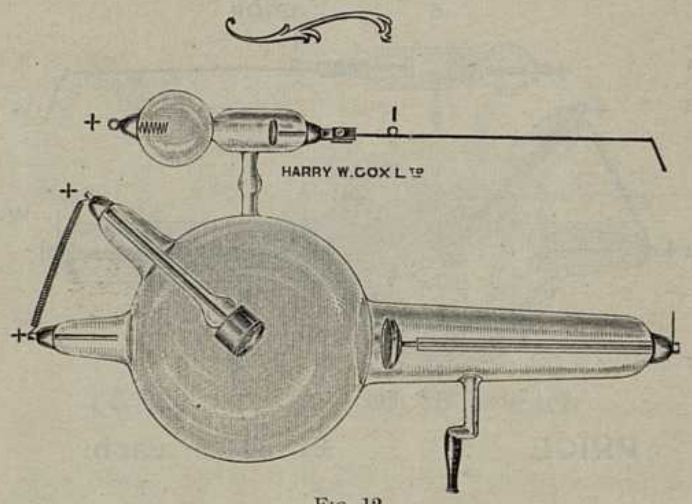


Fig. 12.

PRICE ... £2 15 0 each.

This is of the same size as Fig. 11, but fitted with a heavy anode, which does not heat so rapidly when powerful currents are used. It will consequently prove a great acquisition when either the Mackenzie-Davidson or Electrolytic Breaks are in use. The directions given on the previous page will apply to this Tube also.

Testimonials. . .

An Officer, R.A.M.C., writes on 22nd September, 1903:—"Your Tube is a great success."

S. G. writes from Lincoln, on 13th October, 1903:—"I have been using the Heavy Anode Tubes for a long time and found them eminently satisfactory. I have one which has been in constant use for two years; in fact I have done all my lung cases with it, and in spite of being used occasionally with the Electrolytic Break, it is as good, if not better than when I first had it."

Cox's "Record" Non-Heating Regulating, Water-cooled Tube.

For use with the Wehnelt Electrolytic Interruptor.

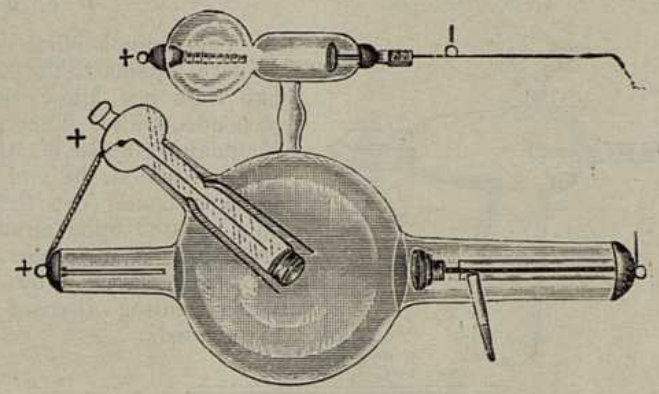


Fig. 13.

PRICE ... £5 0 0.

The anode of an ordinary Tube is soon destroyed if used for any length of time with an Electrolytic Interruptor, in consequence of the great heat.

The above Tube is fitted with a reservoir surrounding the anode, which is three parts filled with water. This keeps the anode cool, and allows of the use of a much stronger current. The regulation is effected in a manner similar to that described under Fig. 11.

This Tube should never be used, even momentarily, without filling the reservoir three-parts full, and replenishing it as the water evaporates. Non-observance of this precaution will destroy the Tube.

Single Anode Tubes.

PRICES.

2½ in. Bulbs, suitable for Coils giving 3 in. to 6 in. spark	£0	17	6	each.
Do. do. do. giving 6 in. to 14 in. spark	1	0	0	„

Clark's Special Dental Tube.

This Tube, the invention of Mr. Clark, is intended for use inside the mouth, so that the Fluorescent Screen can be held against the face of the patient.

Price on application.

Special Tubes for Therapeutic Treatment.

PRICES.

With window of 1 in. diameter, or less ... ... **£1 0 0** each.
Do. 2, or 2 in. do. ... ... **1 5 0** ,,

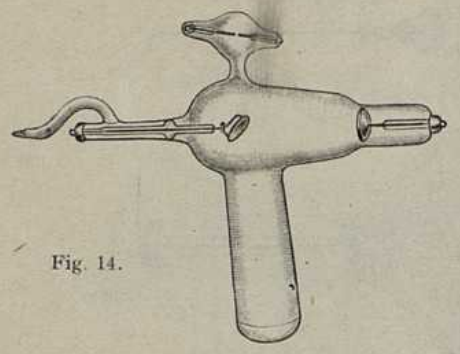


Fig. 14.

This Tube is made of glass which is opaque to the X-Rays, and does not allow them to pass effectively. They pass in abundance, however, through the window at the end of the projection, and can easily be concentrated upon any desired spot, so that the necessity for screening the healthy tissues while treating diseased parts, is obviated.

Dr. Martin's X-Ray Director.

PRICE .... £0 10 0 each.

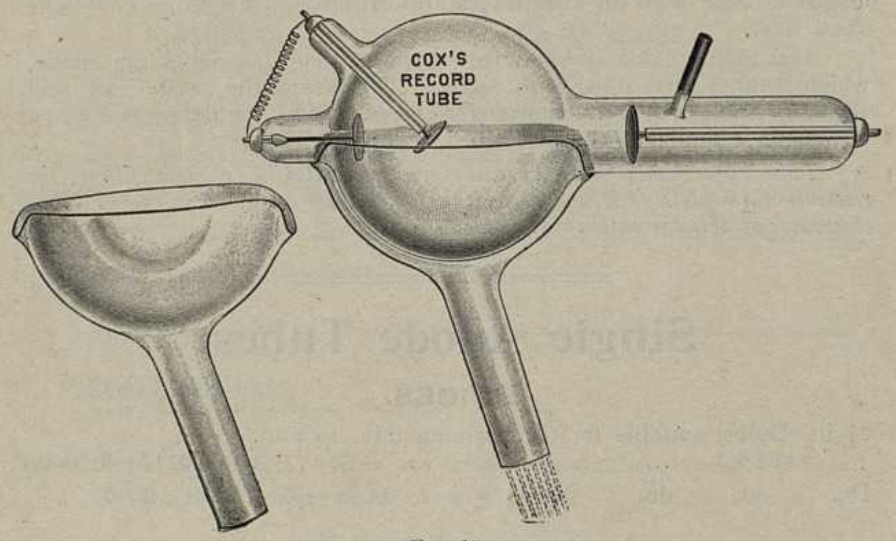


Fig. 15.

This is the invention of W. Martin, Esq., M.A., B.Sc., M.B., C.M., of Cardiff, and will be found useful for applying the Rays to any part of the body, and also for internal application.

It is made of lead glass, which is opaque to the Rays. It can be used with almost any of the X-Ray Tubes, and there is no risk of the patient receiving a spark.

Fluoroscopy.

TUBE HOLDERS.

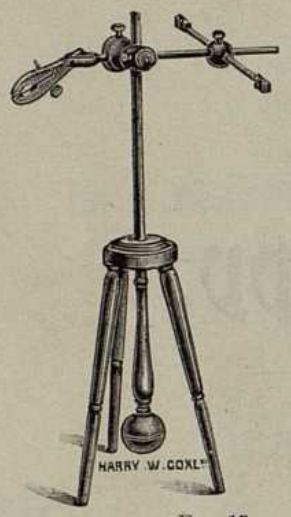
Table Tube-Holder.

This form of Holder is intended for use on a table. It has universal joints and guides for the wires, and its base is weighted with lead.

The standard may be separated from the base and screwed into the top of our Portable Coil, as shown in Fig. 2.

PRICE ... £0 14 0

FIG. 16.



Bedside Tube-Holder.

This is the most convenient pattern for a Consulting-Room or Hospital. It is constructed of Mahogany, with Box-wood screws, and there is no danger of its attracting sparks, as is the case with metal stands. The ball below the tripod is weighted with lead, so as to ensure stability, and the clamp will hold a tube in any position wished for.

PRICE ... £2 0 0

FIG. 17.

Ball-Socket Bedside Tube-Holder.

The advantage of the Ball-socket is that the position of the Tube, and especially of the Anode, can be altered in any direction without the trouble of re-adjusting the screws. And the Tube-carrier can be lowered sufficiently to be placed beneath the couch.

PRICE £2 0 0

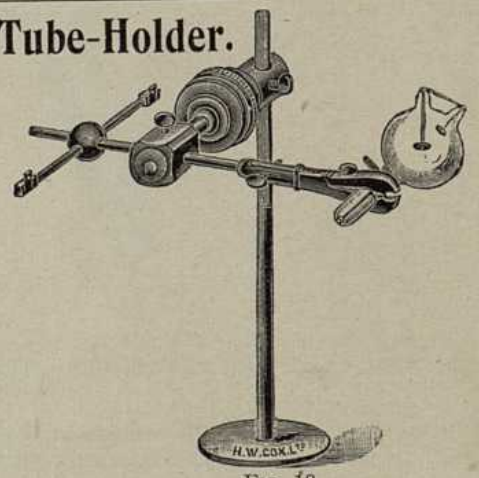
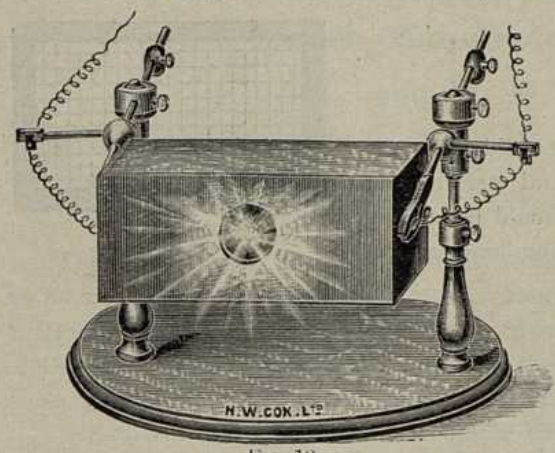


FIG. 18.

X-Ray Tube Box and Stand.



This apparatus was designed by Mr. Manns, Assistant Radiographer at the Middlesex Hospital, and is specially useful in protecting the operator from the effects of the Rays, and also protects the healthy tissue of the patient in cases where it is advisable to do so; for this purpose a diaphragm with apertures of different sizes can be supplied. As will be seen from the woodcut, the box can be tilted into any position, and the Rays thus directed on to any desired spot.

PRICE of Box and Stand, £3 15 0

FIG. 19.

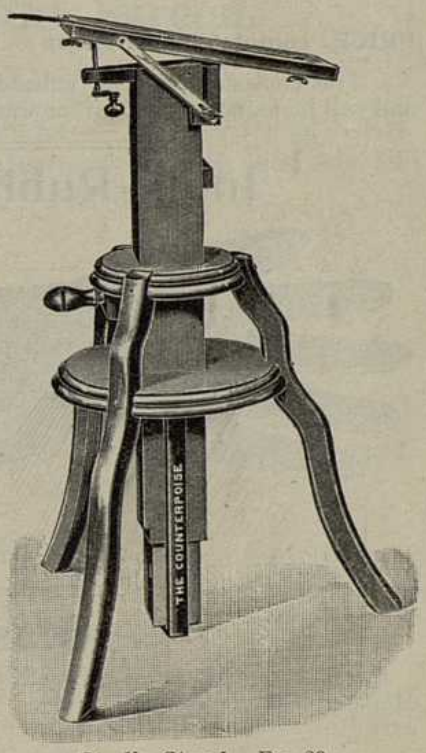
Diaphragm.

To cover opening in box with different sized apertures .. .. **15s. 0d.**

. Studio Stand. .

As this Stand can be adjusted to different heights and angles, it is very useful for putting plates on when taking radiographs of the hand, arm, foot, or legs.

PRICE ... ... 15s. 6d.



Studio Stand.—FIG. 20.

Aluminium Shield.

(Suggested by Dr. Mills, of Norwich).

PRICE, with Terminal...5s. 6d.

This Shield is 24 inches square, and connected to earth by a wire—and being placed between the patient and the Tube, is a protection against electric shocks.

Sheet Lead.

PRICE per piece of 18 inches square, 1s. 0d.

Useful for protecting healthy tissue during the treatment of lupus, rodent ulcers, etc. A hole is cut in the sheet so as to allow the rays to reach the affected part. In treating the face it is usual to cover a mask with lead, and make a hole through both where required.

Wire Tube=Tester.

PRICE ... 8s. 6d.

When this Frame is held near the tube, and the screen several feet from it, the shadow of the wires should be sharply defined if the tube is sound, and capable of doing good work.

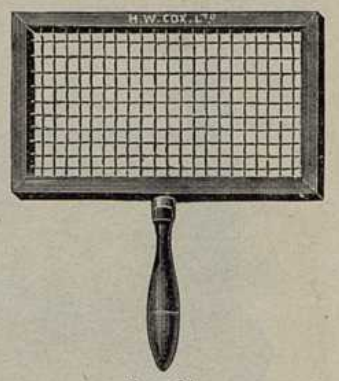


Fig. 21.

Insulated Handle for Holding Spirit Lamp.

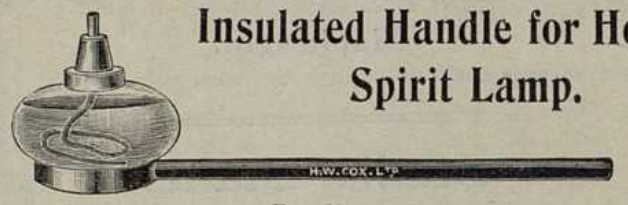


Fig. 22.

PRICE, complete with Lamp ... ... 8s. 0d.

This consists of a long vulcanite handle, with spirit lamp attached and will be found convenient for warming the Tubes while working.

India=Rubber Gloves.

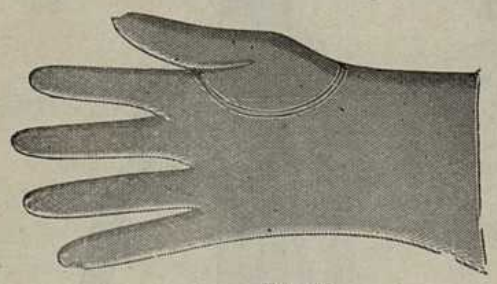


Fig. 23.

For protecting the operator's hands from the effects of the Rays.

PRICE,

From 7s. 6d. to 10s. 6d. per pair.

These Gloves are made of specially thick rubber at the back of the hands.

Glasses.

For protecting the eyes from the rays. The invention of Mr. Clarke, Member of the Roentgen Society. They are made of lead-glass, optically cut.

PRICE, per pair ... ... **6s. 6d.**

Cox's Perfected Fluorescent Screens.

English Manufacture.

PRICES.

5 × 7	...	each,	£1 2 0	9 × 12	...	each,	£3 0 0
6 × 8	...	,,	1 8 0	11 × 15	...	,,	4 10 0
7 × 9½	...	,,	1 19 0	14 × 18	...	,,	7 0 0

These Screens are now very generally used all over the country, and we have received many flattering testimonies as to their superiority for X-Ray work, from eminent authorities on the subject. They are double-coated with platino-cyanide of barium on the best quality of vellum, carefully selected, and stretched upon strong mahogany frames.

If desired, we can, at a small additional cost, fix a pane of glass on the Screen. This has the double effect of preserving the Screen from dust and injury, and of protecting the observer's eyes without obscuring the fluorescence.

Clark's Dental Screen.

PRICE, with Fluoroscope ... ... £1 0 0.

Specially designed by Mr. A. Clark for use with his Dental X-Ray Tube, described at page 27. It can be used with any other tube for making examinations of the face, &c., its size being 4 × 4.

Finger Guards.

PRICE per pair ... ... 2s. 6d.

These are metal shields attached to the frame of a Screen, to protect the operator's fingers from the Rays during a prolonged examination.

. . . Rayometer. . .

PRICE ... ... £0 17 0.

Specially designed, and determines very accurately the penetration of the tube.

Fluoroscopes.

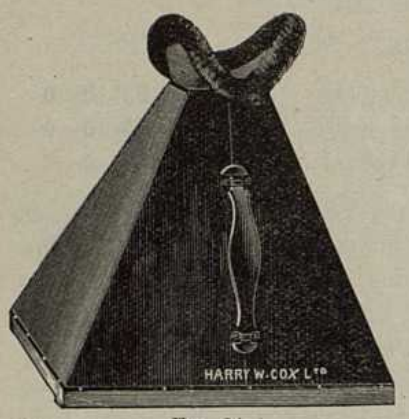


Fig. 24.

The two patterns of the ordinary Fluoroscopes which we supply are here represented.

Fig. 24 is rigid, being made of thin wood covered with leather, and Fig. 25 has a collapsible leather bellows hood, and a polished Mahogany frame.

Both are fitted with flexible eye-apertures to exclude the surrounding light, and will be found useful where a dark room is not available.

PRICES.

To take Screen 7×9

Rigid ...	...	...	£1 4 0
Collapsible	...	...	1 18 0

To take Screen 9×12

Rigid ...	...	...	£1 10 0
Collapsible	...	...	2 0 0

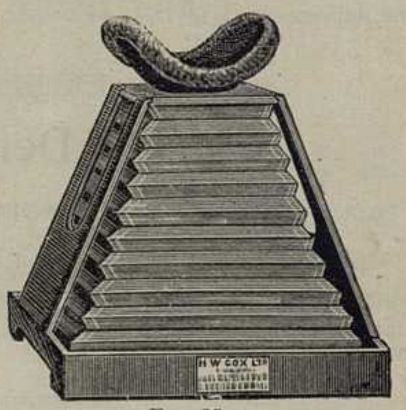


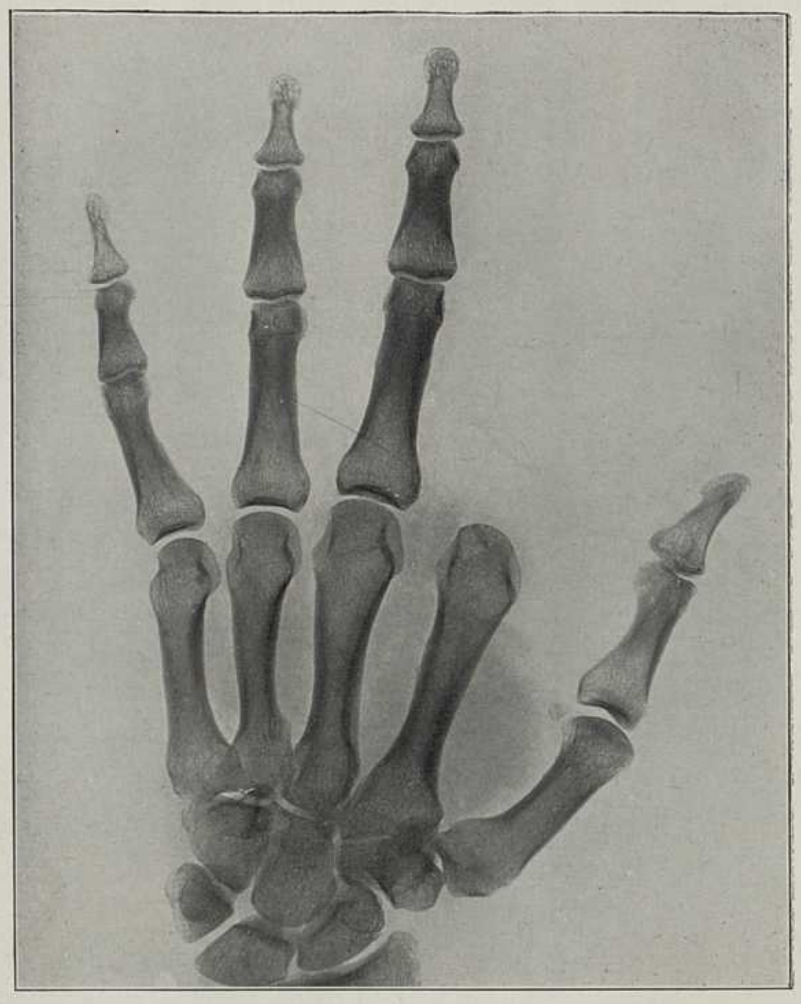
Fig. 25.

Dr. Harrison Low's Tube-Testing Fluoroscope.

Fig. 26.

This small device is intended for proving the penetrating power of tubes, and for making examinations in situations where a larger apparatus cannot be conveniently held.

PRICE, with Screen ... £0 7 6



Radio. of Hand, taken by H. W. Cox.

Exposure 5 seconds.

Radiography.

Cox's Flexible Intensifying Screens.

For Reducing Exposures.

PRICES.

10 × 12	...	...	...	each,	£1 12 0
12 × 15	...	...	...	„	2 15 0
16 × 20	...	...	...	„	3 15 0

These are made of materials which, on being placed under the influence of the X-Rays fluoresce blue, and assist in producing a photograph rapidly. They are a great improvement on any yet produced. They are flexible, and the grain is as fine as that of the photographic plate, and the best yet produced.

N.B.—The mat side of the Screen is placed next to the film on the plate, and must be kept in close contact.

Mr. ALFRED L. STENT, Hon. Radiographer Victoria Hospital, Emsworth, Havant, writes, March 30th:—

"I have tried the new Calcium Intensifying Screen which you sent me, and am delighted with it. It very considerably reduces the exposure necessary for any subject, and it is quite free from grain, which is quite an advance on the others I have had. Please send me on at once a larger one."

Mahogany Dark Slides.

For Holding the Intensifying Screen close to Plate.

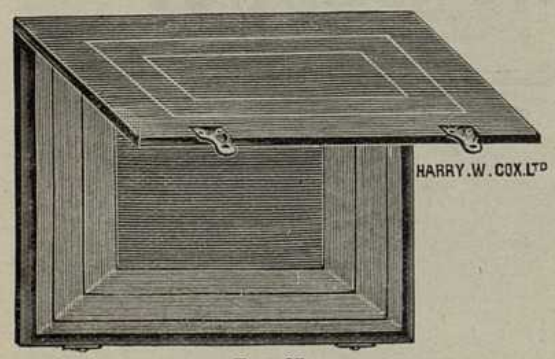


Fig. 27.

These Dark Slides contain adapters for taking several smaller sized plates, and enable the operator to dispense with paper envelopes. They can be used for ordinary exposures without the Intensifying Screen.

To take 10 × 12	Intensifying Screen and Plate	...	...	£1	6 8
„ 12 × 15	„	„	...	1	10 0
„ 16 × 20	„	„	...	2	0 0

Cox's Double Dark Slide.

For Holding Two Plates.

PRICE, to take up to 10 × 12 Plates ... £2 0 0.

This is to enable the operator to take two Radiographs without leaving the room to change the plate.

"Lumiere" X-Ray Plates.

PRICES, per dozen.

	£	s.	d.
Half-Plate		4	8
Whole-Plate		8	6
8×10		13	6
10×12	1	0	0
12×15	1	13	0

Edwards' Cathodal Plates.

PRICES, per dozen.

	s.	d.
Half-Plate	2	3
Whole-Plate	4	3
8×10	7	3
10×12...	10	6
12×15...	18	0

We can supply any other plates that may be required, such as Cadett, Warwick, Schleussner, etc.

Envelopes for holding Plates or Films.

PRICES per dozen pairs.

	s.	d.
Half-Plate, $6\frac{1}{2} \times 4\frac{3}{4}$...	1	6
Whole-Plate, $8\frac{1}{2} \times 6\frac{1}{2}$	2	0
8×10	3	6
10×12	5	0
12×16	10	0

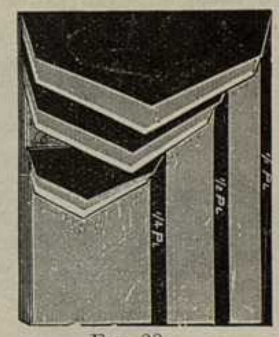


Fig. 28.

The plate is placed in the yellow envelope, with the film side to the front, and then the yellow envelope is passed, open end first, into the black envelope, so as to exclude the light in the event of the flap of the latter coming open.

Dr. Hall Edwards' Stereoscopic Tube-Holder.

PRICE £4 10s. 0d.

This will prove a useful appliance where space is limited, or when an X-Ray couch is not available.

Dr. Hall Edwards' Plate-Changing Box.

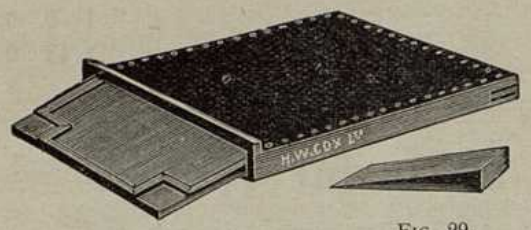


FIG. 29.

PRICES.

To take plates up to 10 × 12
£1 6 8.

To take plates up to 16 × 20
£2 0 0.

It is necessary in stereoscopic work to take two Radiographs on separate plates without moving the patient. This can be done easily by means of the above apparatus.

The Gregorian Stereoscopic Tube and Plate-Holder.

This was invented by Mr. Gregory, of Paignton, for taking small Stereoscopic Radiographs of any part of the hand, foot or arm. As shown in the figure, one half of the plate is exposed while the other half is protected by a metal cover. Half-plates are used, and the prints can be viewed in an ordinary stereoscope.

PRICE ... £2 10 0.

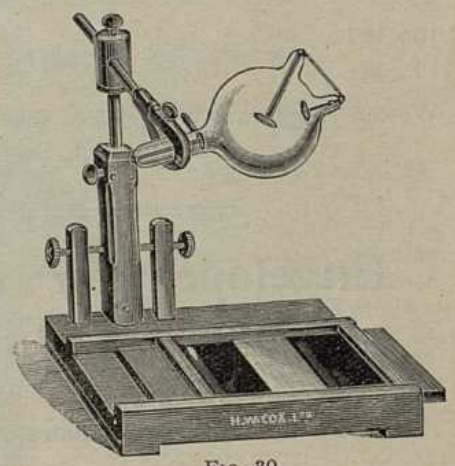


FIG. 30.

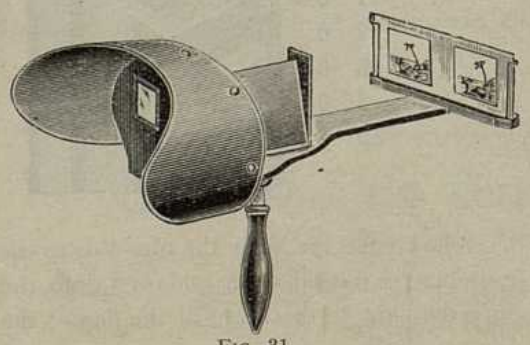


FIG. 31.

Hand Stereoscope with Sliding and Folding Holder.

For viewing small prints
1s. 6d.

Larger size, velvet-lined,
2s. 6d.

The Wheatstone Reflecting Stereoscope.

Intended for viewing radiographic stereoscopic prints, in the manner here illustrated. The exact position of the foreign body or fracture is thus easily seen. Constructed with special mirrors to give the best results.

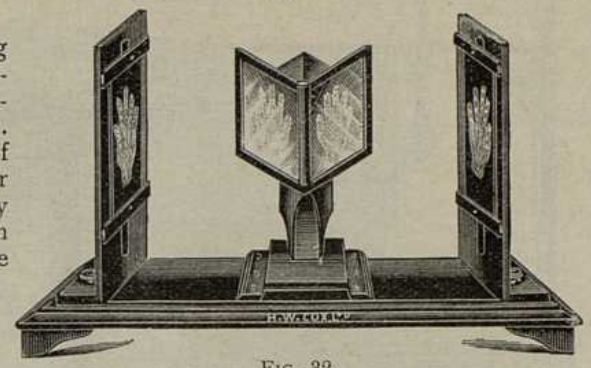


FIG. 32.

PRICES.

As in illustration	**£2 10 0**
Combined with arrangement for viewing negatives ...	**3 10 0**

Dr. Mayo's Stereoscope for Viewing Negatives.

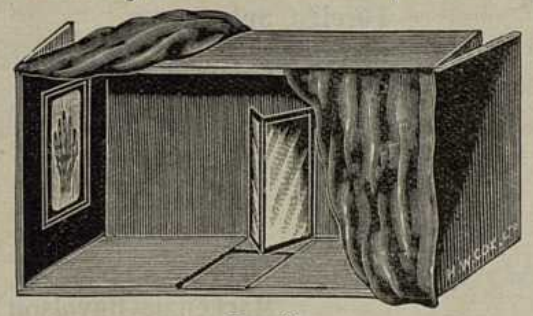


FIG. 33.

This has been designed for viewing negatives in daylight. Opal reflectors are hinged on both ends of the case, and the viewer's head is covered so as to exclude the light.

PRICE,
to take 12 × 15 plate,
£5 0 0.

Negative . . Viewing Stand.

Fitted with a special reflector so as to cast a strong light through the negative, thereby showing up any foreign matter or fracture which might be overlooked if viewed in the usual way.

PRICE,
for sizes up to 8 × 10 plates,
£1 11 6.

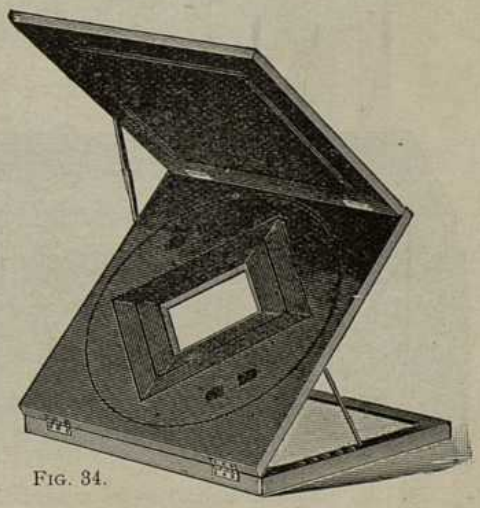


FIG. 34.

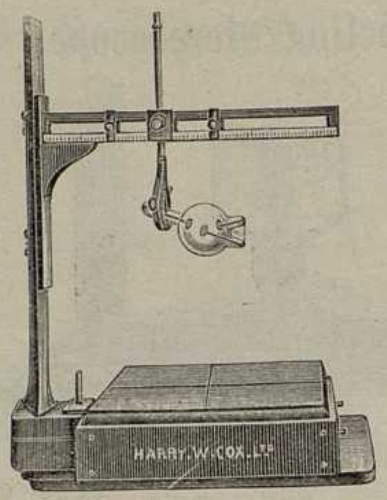


Fig. 35.

Mackenzie-Davidson's Localising, or Stereoscopic Apparatus.

PRICE ... £6 6 0

For instructions see Appendix VI.

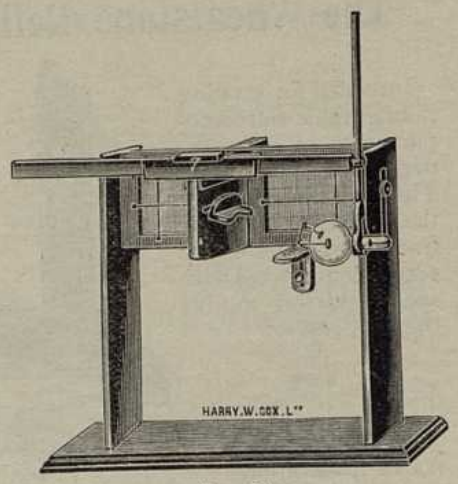


Fig. 36.

Mackenzie-Davidson's Apparatus for Localising Foreign Substances in the Eye.

PRICE ... £5 5 0.

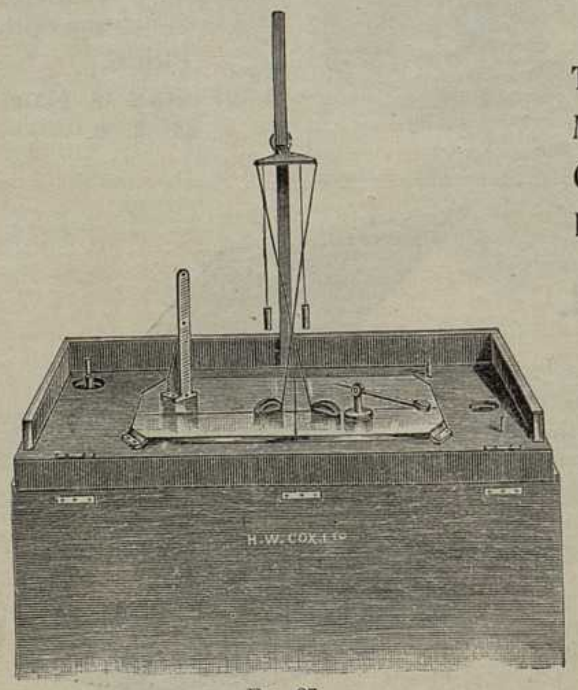


Fig. 37.

The . . Mackenzie-Davidson Cross-Thread Localiser.

PRICE ... £8 8 0.

This is used for localising after a Radiograph has been taken. A full description, with instructions for using, will be found in Appendix VI.

Cox's Portable Cabinet.

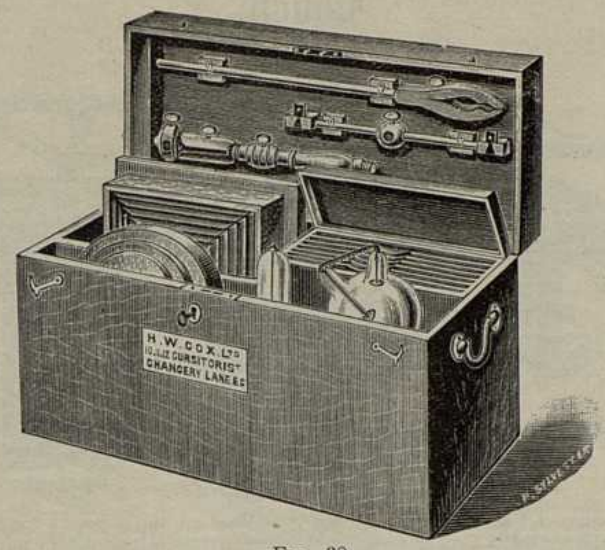


Fig. 38.

This consists of a convenient case for holding 2 Record Tubes, Screen, Mahogany Dark Slide, Tube-holder, Collapsible Fluoroscope and Lead-lined Box to take ½ dozen 12 in. × 10 in. Plates in envelopes. It will be found most convenient for surgeons and others who wish to take the apparatus to the residence of the patient. It is made as small as possible, and contains everything except the Coil and Accumulator.

PRICE of Box only (to take Screen up to 12 in. × by 9 in. size, 2 Tubes, etc.), **£2 10 0.**

Dr. Shenton's X-Ray Couch.

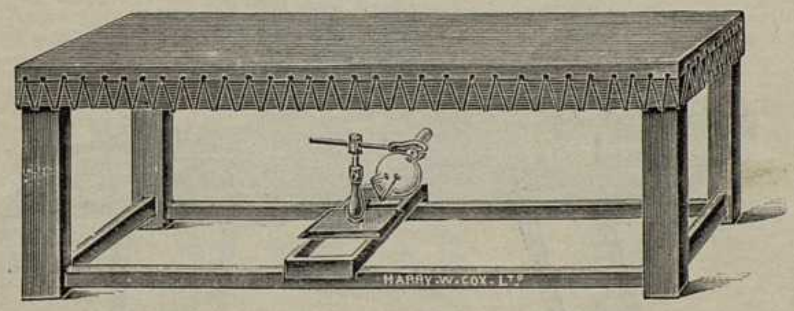


Fig. 39.

This is one of the most convenient Couches in the market. The Tube can be enclosed in one of our special boxes, or placed on a slide under the couch, and it may be moved vertically or horizontally, as desired. The operator is thus enabled to examine with the screen, or to take a radiograph of, any part of the body without moving the patient. The couch is covered with a material which is quite transparent to the X-Rays, and the sensitive plate is usually laid upon the patient. If a stereoscopic picture is required, the patient's skin is marked so that the second plate can be placed in exactly the same position as the first.

PRICE, in oak, with a box to take a large size Tube, **£10 0 0.**

Dr. Hall Edwards' Localising or Stereoscopic Couch.

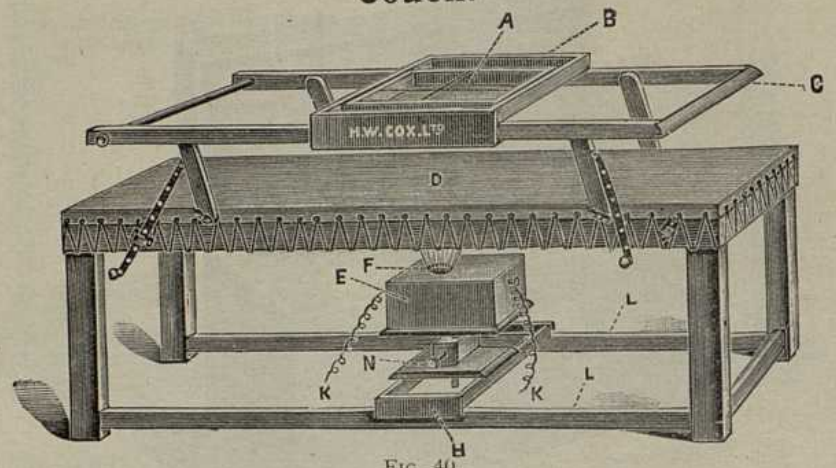


FIG. 40.

Somewhat similar to Dr. Shenton's, described on the previous page, this Couch is fitted on the top with a special localising plate-carrier, which can be adjusted in any position over the patient. See Appendix VII.

PRICE, with box for large size Tube, **£12 0 0.**

This, and Fig. 39, are the two Couches at present in most demand.

Mr. Mackenzie-Davidson's X-Ray Couch.

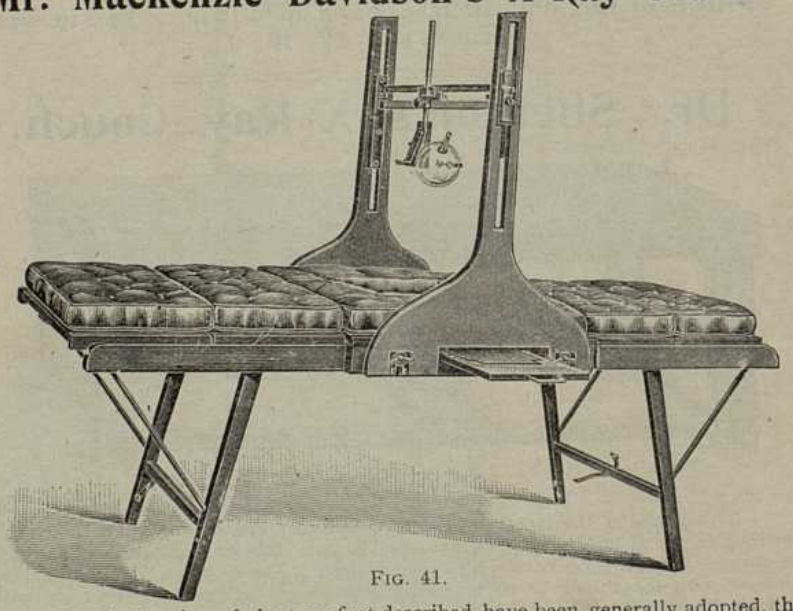


FIG. 41.

Although Couches of the type first described have been generally adopted, that here shown can scarcely be surpassed for precise localisation and stereoscopic purposes. It will be seen that the Tube is placed above the patient, and the plates underneath him. The latter are changed by means of a slide inserted at the side of the upright.

PRICE, complete, £10 0 0.

Dr. MacIntyre's X-Ray Couch.

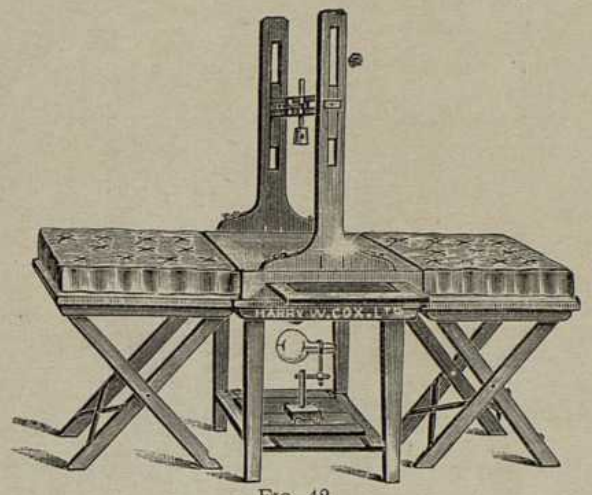


FIG. 42.

Though similar in design to that of Mr. Mackenzie-Davidson, this couch is of somewhat different construction.

It is well adapted for field-work, or places where there is not much spare room, as it can be taken to pieces and put aside when not in use.

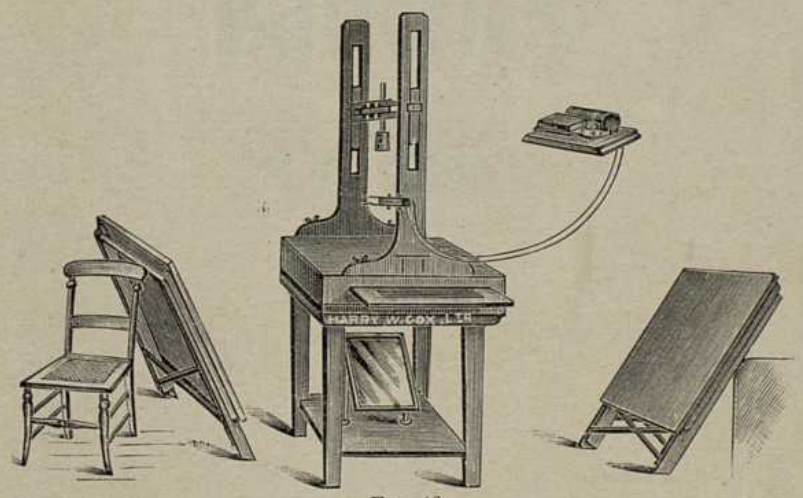


FIG. 43.

The skin-window can be placed in the middle, or at either end of the couch. It is supplied with a mirror to enable the operator to see upon the screen that portion of the body which he is engaged in radiographing. And the Tube can be placed either above or below the patient, as desired.

PRICE, complete .... £11 5 0.

Primary & Secondary Batteries.

Accumulators, or Secondary Batteries.

Accumulators are the most satisfactory batteries for X-Ray work, when means are at hand for re-charging. They are constant, compact, and more portable than primary batteries; in addition to which they can be re-charged at small cost at any electrical works, or where there is a dynamo, or electric light installation.

These cells are made up in teak boxes, and have leather handles; the inner cells being vulcanite or xylonite. Accumulators when sent by rail fully charged, are only carried at owner's risk, and we can in no way be responsible for any accident which may occur from the upsetting of the acid or otherwise. In most cases, however, the railways refuse to take them with the acid in them.

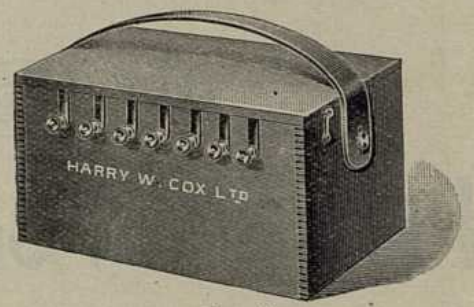


Fig. 44.

The usual size we recommend is 6 volt 60 Ampere Hour capacity, but where portability is an essential we recommend either 6 volt or 12 volt accumulators of 30 Ampere Hour capacity.

The 60 Ampere Hour accumulators are open cells, and consequently can be easily repaired; but we can supply them sealed if desired. The 30 Ampere Hour accumulators, being recommended for portability, are closed in at the top with vent holes fitted with plugs. Any other type of accumulator can be supplied, generally from stock.

The manufacture of accumulators improves almost daily, but what we now recommend is :—

6 volt	60	Ampere	Hour	accumulators	...	...	**£3 10 0**	each.
6 ,,	30	,,		,,	...	...	**3 0 0**	,,
12 ,,	30	,,		,,	...	...	**6 0 0**	,,

N.B. The above cells can be had fitted with terminals for connecting 2, 4, 6, 8, 10 or 12 volts at an extra cost of **5s.** to **10s.**

The above cells are of the very latest and best type, and though the price is a little higher than those we previously listed, it is more than compensated for in the efficiency of the cells.

When working off the platinum interruptor 12 volts–18 volts are required, and with the mercury interrupor 24 volts or more can be used.

Full instructions for charging are sent with each order. See Appendix XI.

Hicks' Patent Hydrometer for Cells that are sealed in Boxes.

Fig. 45.

This consists of a glass tube, inside of which are three beads. One end of the tube is fitted with a rubber teat, and the other end is fitted with a small rubber tube.

All that is necessary is to insert the end of the rubber tubing in the acid, squeeze the teat sufficiently to exclude the air in it; then release the teat, when the acid will rise inside the tube, and the bead floating nearest the centre indicates the specific gravity of the liquid.

PRICE, complete in case ... ... 5s. 6d.

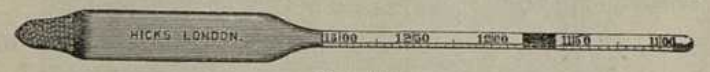


Fig. 46.

These will be found useful for testing the specific gravity of the acid before putting it into the Accumulators.

PRICE ... ... 3s. 6d. each.

Cox's Record Cell-Tester.

In testing an accumulator with a voltmeter it will often register full voltage, on account of the accumulator recovering itself if left alone for a day or two, but it runs out immediately it has work to do. When using Cox's Record Cell-Tester, which consists of an electric lamp and suitable connectors (these being pressed into the tops of the lugs to make contact), if the accumulator has plenty of current in it the lamp will burn with a white light, but if it is nearly run out the lamp will burn a dull red.

PRICE.

Complete with one 6-volt lamp for testing 3-cells and one 2-volt lamp for testing one cell only, **12s. 6d.**

Resistance Coils.

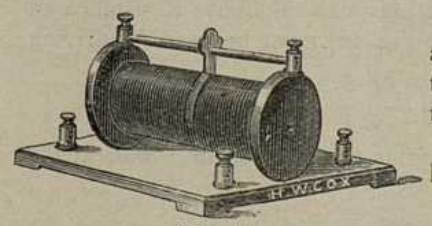


Fig. 47.

In order that the current from an accumulator may be exactly adjusted to the amount necessary, it is advisable to employ a small Resistance Coil.

PRICE, mounted on polished walnut base, as Fig. 47, **17s. 6d.**

Lamp Resistance for Charging Accumulators.

FIG. 48.

A convenient and reliable method of re-charging Accumulators is from an electric light installation supplying a continuous current. To effect this, a suitable resistance (if on the alternating mains a transformer, such as the CHAPLIN RECTIFIER, see page 52, is also necessary) must be inserted in the circuit, or a motor transformer must be used. Our Lamp Resistance consists of six lamps, mounted on a base, and connected in parallel with terminals for joining to mains and Accumulator. We make these to order to suit requirements, and shall be pleased to submit prices on application.

The cost of a Resistance suitable for charging six cells is ... **£1 10 0.**

When ordering please state voltage.

Cox's Series Rheostat.

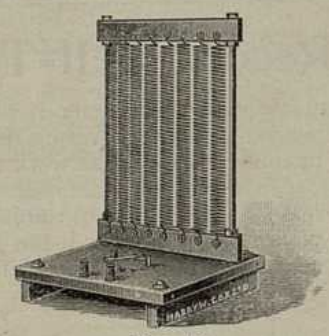


FIG. 49.

This Rheostat will be found useful when working from the supply mains up to 110 volts, and though it differs from the Shunt Rheostat it will give excellent results when used in conjunction with a Mercury Interruptor.

When it is desired to work the Coil through the above Resistance an Accumulator or Lamp Resistance (see Fig. 48) must be used for driving the motor of the Brake.

PRICE of Rheostat as Fig. 49 ... ... **£3 10 0.**

If desired, we can make the above flat to screw on to a wall at the same price.

Full instructions sent with each order.

Cox's Rheostat.

We can make this either for Shunt or Series.

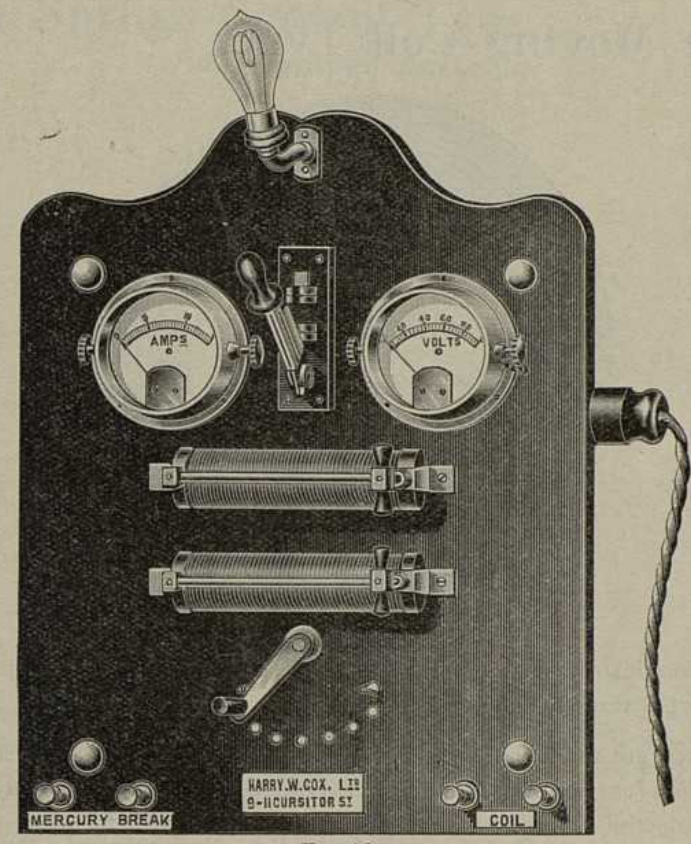


FIG. 50.

When it is desired to work the X-Ray apparatus off the 100 or 220-volt continuous current electric mains a Rheostat must be used in the circuit.

Fig. 50 is most suitable for this and is so constructed that on the 100 or 220-volt mains the voltage can be regulated by means of a switch and the amperes by a small sliding rheostat. (If wound to work in series, which is more economical, the voltage cannot be regulated.)

It is fitted with a second sliding rheostat to regulate the speed of the motor, and a signal lamp to shew if the current is on or off. It is mounted on a polished slate base, and is fitted with terminals for connecting the Mercury Break and Coil. For instructions see Appendix VIII.

PRICE.

Complete as figured, fitted with best quality Ampere and Voltmeter for 100-volt circuit, **£18 10 0.** For 220-volt, **£20 10 0.**
(Cheaper Volt and Ampere meters can be fitted if desired.)

N.B.—These Rheostats do not work off the alternating current—in this case a CHAPLIN RECTIFIER, Fig. 55, or Motor Transformer, must be used.

It is necessary, when ordering a Resistance, to state the Voltage of the electric supply.

AMMETERS & VOLTMETERS.

The Moving-Coil Type.

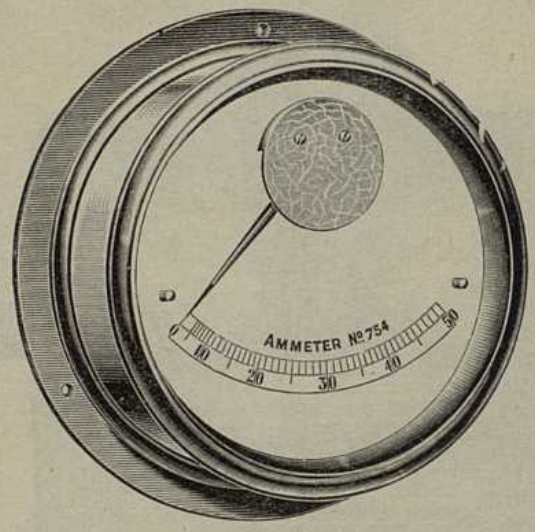


FIG. 51.

These instruments, of the D'Arsonval, or Moving-Coil type, possess the great advantages of dead-beatness, accuracy, and economy.

They are fitted into highly polished and lacquered brass cases, with silver dials, engraved scales and thick bevelled glass fronts. They have hardened steel pivots and jewelled bearings. Each instrument is calibrated individually from absolute standards.

As in Therapeutic work and Radiography the current should always be noted, an Ammeter is an indispensable part of the equipment.

PRICES.

For Ammeters or Voltmeters of any Amperage up to 50, or any Voltage up to 100, with a 4-inch dial **£3 10 0**

Ditto ditto with a 6-inch dial **4 0 0**

Pocket Ammeter.

A serviceable instrument for a medical man who carries about his X-Ray apparatus.

PRICE ... ... £1 5 0.

AMMETERS & VOLTMETERS.

The Spring-Control Type.

(with Damped Actions).

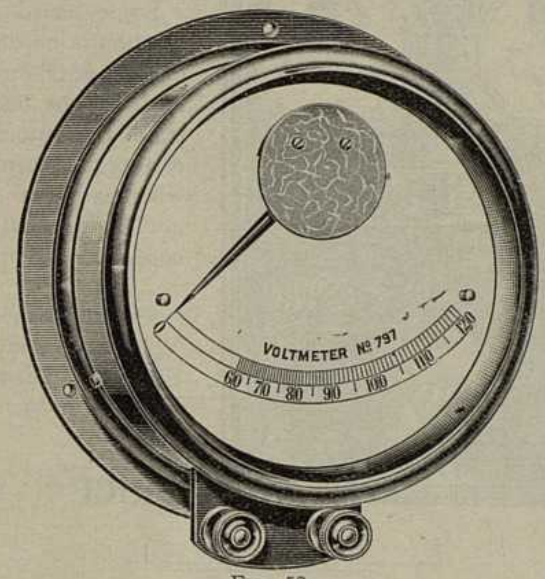


FIG. 52.

These Instruments are finished as described on page 50. They have a painted scale on silvered metal dials, and are fitted with bevelled glass fronts. Every care is taken to ensure accuracy. This is the type we recommend for use with our coils.

PRICES.

For Amperage to 20, or Voltage to 100, with a 4-inch dial,

£3 0 0.

N.B.—We can supply a cheaper German made instrument at £1 5s. 0d.

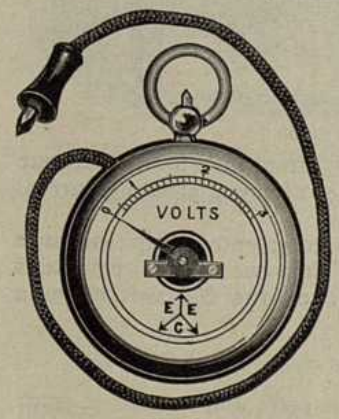


FIG 53.

Pocket Voltmeter.

Suitable for testing separate cells or a number of cells in series.

It is provided with pin-connectors, one fixed to the instrument, and the other to a flexible cord, so that when the battery is not provided with separate terminals for each cell, the pins may be pressed into the lead-lugs to make contact.

PRICE.

Reading to 8 or 14 Volts ... **£1 5 0**

Charging Board.

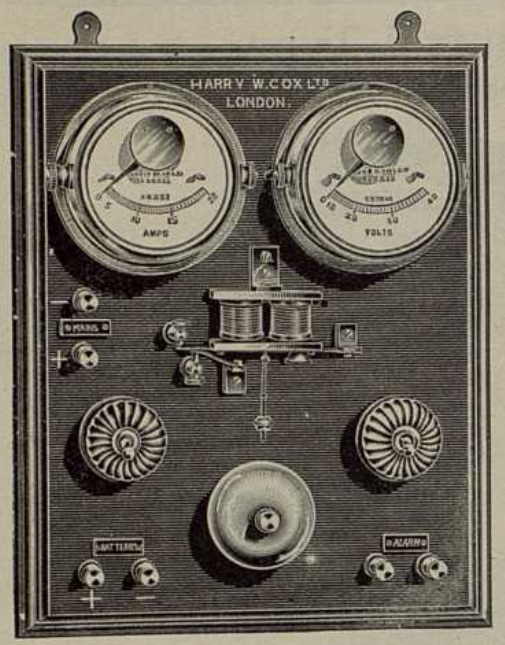


Fig. 54.

For using when charging Accumulators from a Dynamo.

Some board of this description is needed when the current is taken off a Dynamo. In the one here illustrated the Automatic Cut-out causes the alarm bell to ring whenever the Dynamo is not working at a sufficient speed.

Fitted with high class Volt and Ampere meters, Switches, Terminals, Automatic Cut-out and Alarm Bell.

PRICE .... £12 0 0.

Chaplin's Chemical Rectifier.

When an alternating has to be converted into a direct current, for charging accumulators or working the coil, this apparatus will be found a convenient one. It has been in use by Mr. Chaplin for the last eighteen months and, with the improvements he has effected, we have no hesitation in recommending it.

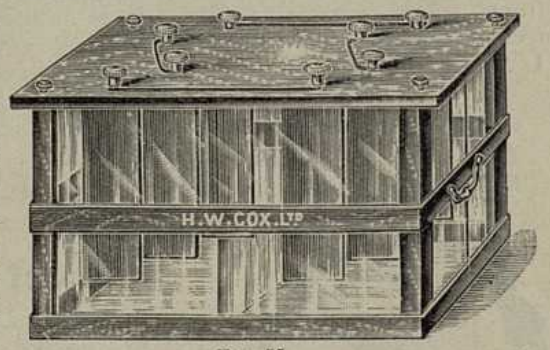


Fig. 55.

It consists of Carbon and Aluminium plates fitted into four stoneware jars, which are so connected that both phases of the alternating current are made use of.

When used for charging accumulators we recommend a lamp resistance (Fig. 48), and when used for working the Coil one of our Rheostats (Fig. 49) will be required, and when working off the 200 volt mains a Transformer, price **£4 10,** is recommended.

PRICE.

Complete, with sufficient salts for charging the cells, and one set of spare Aluminium plates, **£6 6 0.**

Time Switch.

For cutting off the current at any desired period.

This consists of a clock with attachment and switch, mounted on a board, and is intended for charging accumulators for any given number of hours without further attention.

The attachment having been set to a particular time, the current is cut off automatically when the clock points to the hour named.

PRICE ... ... £1 10 0.

Primary Batteries—Dry Cells.

Very fair results can be obtained by connecting up a number of large-sized dry cells, but we do not recommend their use in any case where accumulators can be used. They are principally useful as a stand bye in the event of the accumulators or other source giving out, and we cannot guarantee their output or durability. Good results can be obtained on the platinum break by using 30 large size Obach cells connected in series.

M. size Obach Cells .... 6s. 0d. each.

Other Cells at ordinary prices.

Cox's Bichromate Batteries.

These Primary Batteries are specially constructed by us for working Induction Coils, where it is not convenient to get Accumulators re-charged.

They are made in dove-tailed boxes with a convenient means for raising and lowering the plates; they have a very low internal resistance, which renders them very suitable for working Coils; they are, moreover, easy to charge, and the plates can be easily removed. The carbon is positive and the zinc negative. We recommend two sets of four cells.

The following formulæ will be found to give the best results: Water (cold), three pints; powdered bichromate potash, 18 ozs.; sulphuric acid, 16 ozs. The sulphuric acid must be added drop by drop, so that the solution heats very gradually. *It is very important* that the zincs should be kept well amalgamated.

Another means of charging is by using chromic acid, which dissolves in the water: Water (cold), 6 pints: chromic acid, 18 ozs.; sulphuric acid, 6 ozs.

PRICES.

4 cells complete with carbons	7 × 4	£3	10 0
4 „ „ „	8 × 5½	4	5 0
6 „ „ „	8 × 5½	6	0 0
6 „ „ „	9 × 6	7	0 0

PRICES OF SEPARATE PARTS FOR RENEWAL.

Zinc Plates amalgamated	7 × 4 × ¼	each	1s. 6d.
„ „	8 × 5½ × ¼	„	2s. 0d.
„ „	9 × 6 × ¼	„	2s. 0d.
Best Cut Retort Carbon Plates ...	5 × 4 × 5/16	each	1s. 8d.
„ „ ...	8 × 5½	„	2s. 6d.
„ „ ...	9 × 6	„	3s. 6d.
Bichromate of Potash		per lb.	8d.
Chromic Acid, in powder		„	1s. 0d.
Mercury		per oz.	6d.

Pole finding Paper, for finding the positive and negative wires from an accumulator or electric light continuous current mains ... ... Price per book **2s. 0d.**

Auxiliary Apparatus.

Cox's X-Ray Trolley.

For Hospitals.

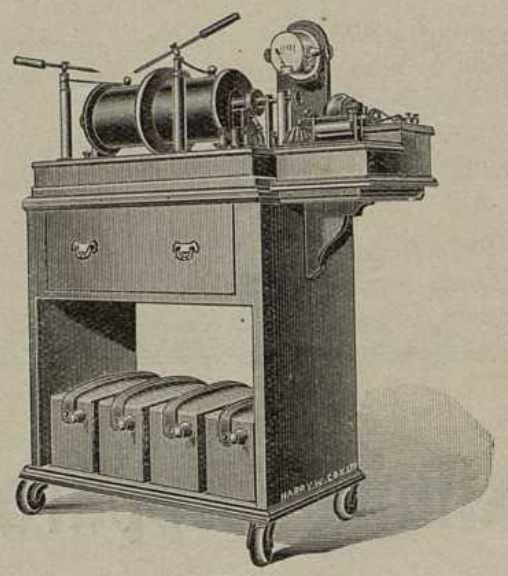


Fig. 56.

PRICE ... ... £7 0 0.

This furnishes a convenient means of conveying the complete X-Ray apparatus from one part of the hospital to another.

The Trolley is constructed of well-seasoned polished mahogany, and the whole is of the finest London workmanship and finish. It is fitted with a leaf on which to place any Mercury Break, and a board to which a Meter may be fixed. It can be moved from floor to floor in the lifts with which most large hospitals are equipped, and the wheels being provided with India-rubber tyres, smooth and noiseless running are ensured.

Trolley similar to the above to take our Portable Coil. Price **£7 0 0**

Cox's Naval X-Ray Trolley.

For Ships or Hospitals.

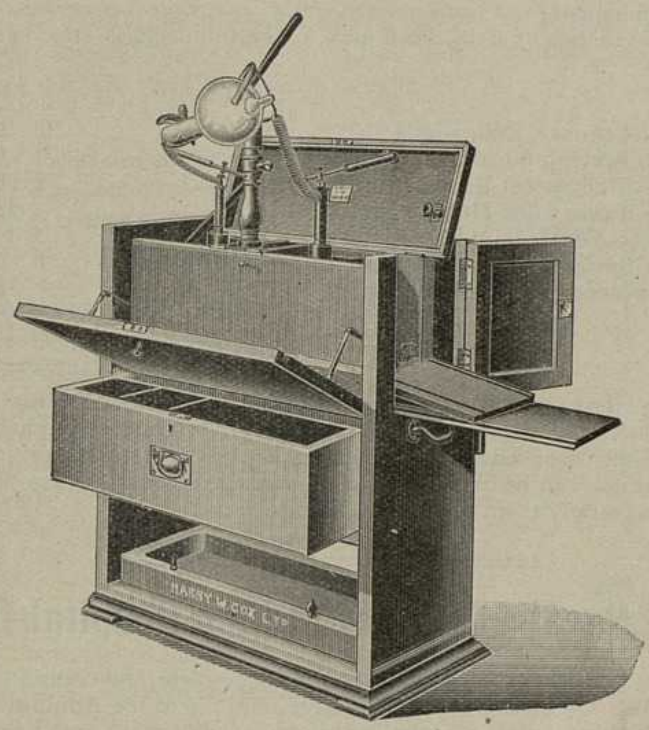


Fig. 57.

PRICES.

Without Castors	**£12 10 0.**
With Rubber-tyred Wheels	**£13 15 0.**

This Trolley was specially designed by us for the Admiralty, and it carries Accumulators, a Portable Coil, Tubes, Stereoscopic appliances, and other accessories. It is equally suitable for Hospitals.

It is fitted with an easy-running drawer, lined with green baize, to contain the Tubes, Plate-changing box, etc., and the top is arranged to carry our apparatus for viewing Stereoscopic prints. See Fig. 32.

The whole is of handsome appearance, made of the best seasoned polished Mahogany, and highly finished. It is undoubtedly the most compact Trolley on the market.

Cox's Practitioner's Outfit.

We are frequently asked to supply an X-Ray Outfit limited to those appliances and implements *which are really indispensable for* the ordinary practice of a medical man. The following is what we recommend:—

	£	s.	d.
One Ten-inch Coil, Fig. 1	25	0	0
Two Six-volt 60 Ampere Accumulators	7	0	0
One Fluorescent Screen, 7 × 10	2	0	0
One Table Tube-Holder, Fig. 16		14	0
Two Gold Medal "Record" Tubes, Fig. 10 ...	1	17	0
One Spring-Control Ampere-meter, damped action	3	0	0
All neccessary connecting wires		5	0
	£39	16	0

The above outfit comprises all that is necessary for ordinary practical X-Ray work, with the exception, of course, of photographic plates, light-proof envelopes, and dishes for developing, printing, and toning, which can be obtained from any dealer in photographic materials, or we can supply them for a few shillings.

Cox's Naval & Military Station Hospital Outfit.

This is, without exception, the most complete and compact outfit in the market. We have supplied a large number to the Admiralty for use on battle-ships, but it is equally suitable for hospitals, and where space is a consideration it cannot be excelled. The outfit includes the following:—

	£	s.	d.
One Naval Trolley, Fig. 57...	12	10	0
One Ten-inch Portable Coil, Fig. 2	30	0	0
One Cox's Localising Slide, fitted to Coil	2	10	0
One Stereoscope (for top of Trolley), Fig. 32 ...	2	10	0
One Fluorescent Screen, 9 × 12	3	0	0
One Table Tube-Holder, Fig. 16		14	0
One Plate-Changing Box, Fig. 29	1	6	8
Two Cox's Gold Medal "Record" Tubes, Fig. 10	1	17	0
One Collapsible Fluoroscope, Fig. 25	2	0	0
Four Six-volt 60 Ampere Accumulators	14	0	0
One Ampere-meter, Fig. 52	3	0	0
One Mackenzie-Davidson Patent Mercury Interruptor	6	16	6
Six pounds of Mercury for ditto	1	1	0
One Dr. Howlett's Hand Switch		6	6
One Couch	12	0	0
All necessary connecting wires		5	0
	£93	16	8

Cox's Hospital Outfit.

The following is what we have supplied to a large number of Hospitals in all parts of the world, and comprises all that is necessary for the best up-to-date results.

One Twelve-inch Coil, Fig 1	£30	0	0
One Fluorescent Screen, 9 × 12	3	0	0
One Mackenzie-Davidson Patent Mercury Interruptor	6	16	6
6lbs. of Mercury for ditto	1	1	0
Four Six-volt, 60 Ampere Accumulators	14	0	0
One Bedside Tube-holder, Fig. 17	2	0	0
One Collapsible Fluoroscope, fitted to take Screen...	2	0	0
One Ampere-meter, Fig. 52	3	0	0
One Hospital Trolley, Fig. 56	7	0	0
Three Cox's Gold Medal "Record" Tubes. Fig. 10	2	15	6
One Dr. Howlett's Hand-switch and Flexible Wire	0	6	6
One Couch	12	0	0
Wires	0	5	0
	£84	4	6

The following testimonial is from the Rev. PHILIP MULHOLLAND:—

"I wish to express my complete satisfaction with the X-Ray Outfit with which you supplied me six months ago. I have now had full opportunity to test the Coil (10-inch) very thoroughly, not only in X-Ray work, but in the course of some experimental work which was calculated to throw very great strain upon the insulation of the Secondary. The Coil, I am pleased to say, has come through the ordeal triumphantly. I find, too, that with a Mackenzie-Davidson Break, I can get a torrent of sparks of 11½ inches in length, without showing any sign of strain.

"Having seen your Coils in all stages of manufacture, I can testify to the soundness of the principle employed, and the practical immunity from break-down, even under unfair strain, which it ensures.

"I am pleased also with the very handsome appearance of the Coil, and the high finish given to all the metal parts. The 'Record' Tubes are doing excellent work. I still occasionally use one which I purchased from you three years ago; this Tube has done during that time a really tremendous amount of work, and has endured heavy and continuous work in a wonderful way."

Spark Gap.

Fig. 58.

By the use of a spark gap in the secondary circuit of the induction coil, the "X" Ray Tube will work more evenly, and the platinum contact breaker be less liable to stick. (Fig. 58). **PRICE 2s. 6d.**

Vacuum Tubes.

These Tubes are principally used for lecture purposes and contain different loose fluorescent minerals, *e.g.*, calcium sulphide, various kinds of shells, foraminiferous marble, coral, Iceland spar, etc.

Fig. 59.

(Fig. 59). **PRICE 12s. 6d.** each.

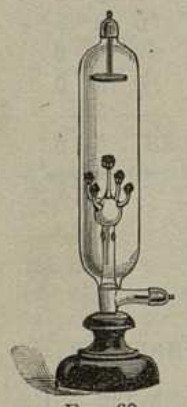


Fig. 60.

Tubes containing different mounted specimens of fluorescent minerals, *e.g.*, calcium tungstate, rubies, shells, dolomite, willemite, etc.

(Fig. 60). **PRICE 18s. 6d.** each.

Shadow of Cross Tube (Fig. 61). **PRICE 12s. 0d.**

Set of four Tubes, 18 in. long, showing different degrees of exhaustion **PRICE 15s. 0d.**

Set of three Tubes, on stand, showing fluorescence of English, German, and Uranium glass **PRICE 18s. 0d.**

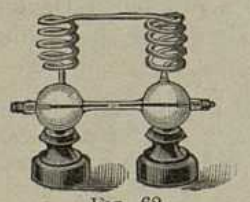


Fig. 62.

Hittorf's Tube, showing the resistance of the dark space (Fig. 62). **PRICE 15s.**

Fig. 61.

Spectrum Tubes.

Containing following gases:—Oxygen, hydrogen, nitrogen, carbonic acid and hydrochloric acid, etc.

(Fig. 63). **PRICE 2s. 6d.** each.
or of Pure Glass **5s. 0d.** ,,

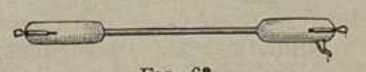


Fig. 63.

Geissler Tubes.

		£	s.	d.
4 in. to 5 in. long, in six different patterns	per doz.		10	6
6 in. ... ,, ,, ,, ...	,,		12	0
8 in. ... ,, ,, ,, ...	,,		15	9
10 in. ... ,, ,, ,, ...	,,	1	1	0
22 in. ... ,, in beautiful patterns	each		12	9

Quotations for Special Designs, such as People's Names, "Good Night," "X-Rays," etc.

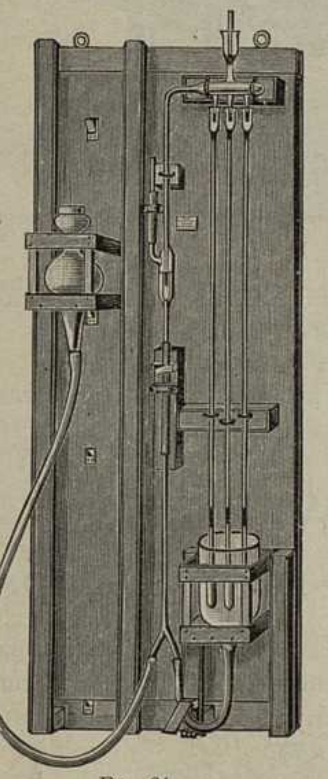


Fig. 64.

Mercury Pump.

This is a pump on Sprengel's principle, and it is a great improvement on the old plan.

The fall-tubes dip into cups of mercury, and a degree vacuum equal to one two-millionths of an atmosphere can be obtained.

PRICE £5 0 0.

McLeod's Gauges.

For measuring vacua to the millionth part of an atmosphere.

PRICE £5 0 0.

Eye-lid Everter.

This Eye-lid Eveter was designed by A. H. Reid, Esq., of King's College Hospital. The eyelids, or lashes, are clipped and then turned back, and can be held in position by means of a tape. It will be found most useful in treating eye cases with the X-Rays.

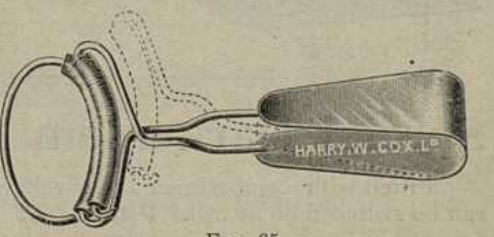


Fig. 65.

The Cox Rocker.

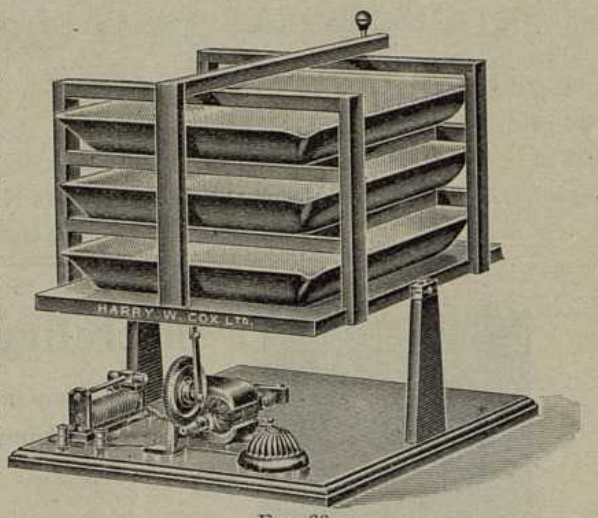


FIG. 66.

This apparatus will be found to be a great assistance to those who have any large number of plates to develop. It is fitted with a motor, switch, resistance and rocking mechanism.

Motors can be supplied working at either 12, 24, or 100 volts, and the rate at which the developing solution is passed backwards and forwards over the plates can be regulated by means of the resistance.

The rocker is made to take 3 developing dishes, so that having immersed his plates in the solution, the operator can leave his dark-room while the development is proceeding.

PRICE, to take three dishes, **£6 10.**

If desired, clockwork mechanism can be provided instead of motor.

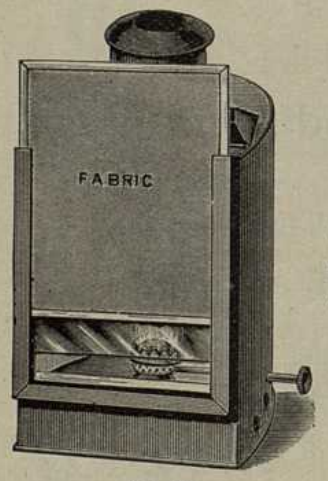


FIG. 67.

The Whitefield Dark-room Lamp.

This may be adapted either for oil or gas. It is well ventilated, and fitted with ruby glass and canary-coloured fabric. Size of glass front, $9\frac{1}{2} \times 7\frac{3}{4}$.

PRICE, 6s. 9d.

With detachable shade, 1s. 3d. extra.

Or fitted with electric switch and lamp, 4s. 9d. extra.

Special Dark-room Electric Lamp.

Fitted with compartments for yellow or ruby light, either of which can be switched on at will. **PRICE, £1 7 6.**

Any other special lamp can be supplied if desired.

List of Printing-out Frames, Developing Dishes and Chemicals in general use.

Printing-out Frames.

TEAK—ORDINARY PATTERN.

Inches.		s.	d.
15 × 12	each	4	0
12 × 10	„	2	9
10 × 8	„	2	0
$8\frac{1}{2} \times 6\frac{1}{2}$	„	1	2

Developing Dishes.

PORCELAIN.

Inches.	Shallow. s.	d.	Deep. s.	d.
16 × 12	5	6	7	0
13 × 11	3	0	4	0
11 × 9	1	9	2	0
9 × 7	1	2	1	5

POPULAR JAPANNED STEEL.

Inches.	s.	d.
15 × 12	2	6
12 × 10	1	9
10 × 8	1	2
$8\frac{1}{2} \times 6\frac{1}{2}$		10

PAPIER MACHE.

Inches.	s.	d.
$15\frac{1}{2} \times 12\frac{1}{2}$	5	0
$12\frac{1}{4} \times 10\frac{1}{4}$	2	9
$10\frac{1}{4} \times 8\frac{1}{4}$	2	0
$8\frac{3}{4} \times 6\frac{3}{4}$	1	3

Printing-out Paper.

ILFORD P.O.P.

		s.	d.
12× 10	8 pieces	2	0
10× 8	6 „	1	0
$8\frac{1}{2} \times 6\frac{1}{2}$	9 „	1	0

Any other kinds of printing-out paper can be supplied at approximately the above prices, except Bromide, which are slightly dearer.

Graduated Measures.

2 oz. ... ... **6d.** each. 10 oz. ... ... **9d.** each.

CHEMICALS.

Any kind of the above can be supplied at market rates, but the following is what we generally send out:—

"Tabloid" = = Pyro Soda Developer

(Ilford Formula).

In Cases containing—Pyro-gallic Acid (No. 1 Solution),
Soda Compound (No. 2 Solution).

12s. 0d. a dozen.

"Tabloid" = = Hydroquinone Developer.

In Cases containing—Hydroquinone (Quinol) gr. 2.
Hydroquinone Accelerator.

12s. 0d. a dozen.

"Tabloid" = = Gold Chloride. =

In Cases containing sufficient for preparing six toning baths	**12s. 0d.** a dozen.
Sulpho-Cyanide Toning Cartols	**1s. 10d.** for six.
Hypo.	per lb. **2d.**

Lamps for Treatment of Lupus, Rodent Ulcer, &c.

The Kent-Cox Ultra Violet Lamp.

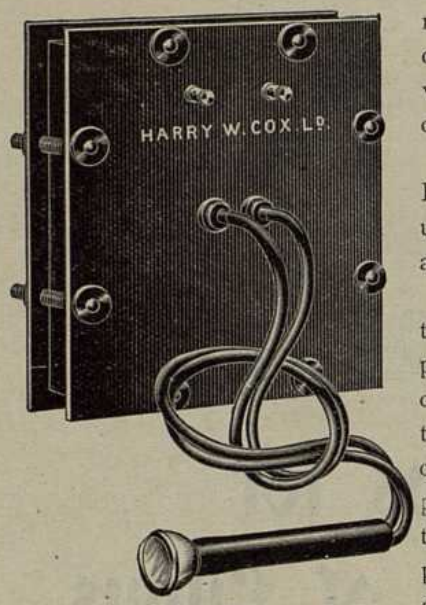


FIG. 68.

This lamp, though similar to many other Ultra-Violet lamps now on the market, possesses many advantages. It is light, portable, clean and very efficient.

It can be worked from any X-Ray induction coil, or from a step-up transformer connected with an alternating supply main.

The quartz lens in front of the lamp can be held close to the patient's skin, and so acts as a compressor to drive the blood from the part under treatment; a piece of ice will answer the same purpose, since the ultra violet rays pass through quartz or ice, but will not pass through glass. If necessary, compressors of any desired shape can be supplied to order.

The conducting part and holder of the lamp is made of polished ebonite, and the two electrodes can be adjusted by removing the quartz lens. The condenser is in a vulcanite case, and owing to the special method of construction, we have been able to dispense with the oil generally used, making the whole apparatus very light, and as there is no oil to run out, it can be stood on any table or carried about with impunity.

The condenser is connected to the lamp by wires fitted into rubber tubing, and it is impossible to get a shock.

The ultra-violet rays produced from this lamp are very powerful, as can be demonstrated by holding a piece of zinc silicate in front of the lens when it will fluoresce green very brightly.

This lamp is in use at several of the London Hospitals for the treatment of Lupus, Rodent Ulcer, etc.

For Instructions, see Appendix X.

PRICES.

Lamp complete with condenser	£8 8 0
A suitable step-up transformer to work off the alternating main	6 10 0

The Cox Lupus Lamp.

(Heathcote Patent).

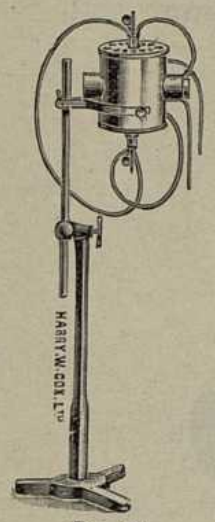


FIG. 69.

The cure of Lupus by means of the very powerful light obtained from the Finsen Electric Lamp has now been before the public for some two years.

The apparatus ordinarily employed at the large hospitals is costly to purchase, expensive in installation, and unpleasant to work. In view of these drawbacks, which place the Finsen Lamp beyond the means of most private practitioners and all but the largest hospitals, experiments have been carried out during the last two years with the object of obtaining an efficient cure, without the above-named disadvantages; and Cox's Lupus Lamp (Heathcote Patent) has now been placed in the hands of the medical profession, and constitutes an indispensable aid to general practice.

PRICE, with Resistance ... £30 0 0

This lamp enables any medical man to apply the "light treatment" for the cure of lupus, malignant ulcer, and similar diseases, with a comparatively small outlay for the purchase and installation of the apparatus, and trifling expense for the working.

By the internal arrangement of the lamp the maximum heat is given out, while the minimum of heating effect is felt. This result is brought about by investing each carbon with a tightly-fitting jacket in such a way that only about one-eighth of an inch of carbon is exposed at each pole.

As a consequence of such thorough cooling of the poles very much thinner carbons can be used than are usually employed in an arc-light; and yet 10, 15, or 20 amperes can be carried without over-heating. The effect of the carbon being so small is that the intensity of the light is greatly increased.

The ordinary water-cooled lenses are employed, and the focus brought to bear upon the patient at five or more inches from the outer lens. The arrangement of the lenses is however such that the effect and intensity of the light is as powerful as if the surface exposed was within an inch of the arc, but without that burning heat which would be experienced under such conditions. The area heated may be larger, and the exposure shorter than with the Finsen light.

The lamp as sent out is arranged so as to be applied to only one patient at a time, but if required, it will, at a small additional charge, be adapted for the treatment of two, three, or four patients at once. It is important to add that, even with four patients there is no increase in the working expenses. The lamp is easy to manipulate, and as a rule one nurse can do all that is requisite for four patients.

The Finsen Light Treatment

with the London Hospital Lamp.

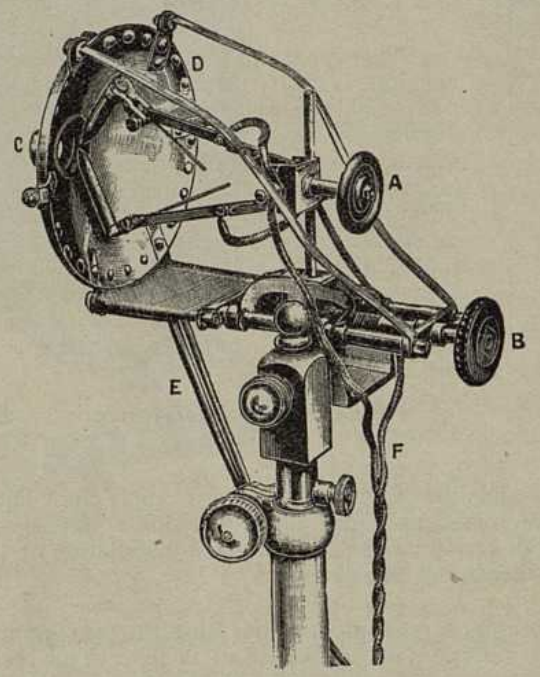


Fig. 70.

This Lamp was designed by Mr. Thos. Smith—the Chief Engineer of the London Hospital—at the suggestion of Dr. Sequira, and being of open pattern all parts are easily accessible and in view of the operator. The arc or carbon points are brought very close to the skin, which can be viewed by the operator through the lenses while the patient is undergoing treatment. It is very strongly made, and can be fixed in any position. The shield and lenses are cooled by water circulating through or between them.

PRICE **£20 0 0**

STANDARD SWITCHBOARD, for use with this Lamp ... **£5 5 0**

Patent Concentrating Lens.

For use with the London Hospital Lamp.

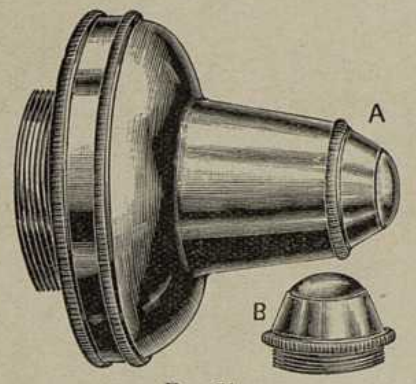


Fig. 71.

By means of these lenses the light from the arc of the lamp can be concentrated with intense brilliancy on a small spot, and their general shape enables the compressor to be applied to small places which are difficult to get at with the large lens. It is completely water-cooled, and is a great adjunct to the lamp.

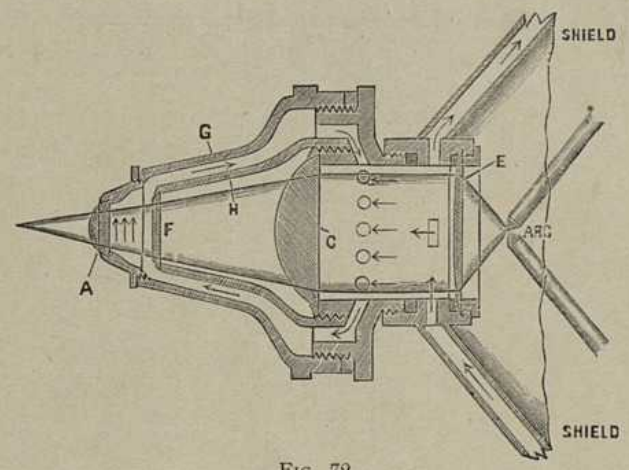


Fig. 72.

PRICES.

With One Compressor	**£3 10 0**
With Four Assorted Compressors	**5 0 0**
Separate Compressors ... ... each	**0 10 0**

High Frequency.

Cox's High Frequency Apparatus.

TESTIMONIALS. . .

A Doctor writes:—

"I have had the misfortune to break the smaller of the two glass electrodes you sent with the apparatus. As I cannot continue the treatment until I get another, would you kindly send it to me to-morrow, as I am very anxious not to be without the treatment. The apparatus has worked splendidly, and so far without any trouble."

T. COKESQUANCE, Esq., M.D., writes from Sunderland:

"I enclose cheque value £4 7s. 6d., receipt of which please acknowledge. I am very pleased with the new High Frequency apparatus; it is beautifully finished and very efficient."

Dr. YOUNG writes:

"I find your apparatus stands high in merit. Results are excellent."

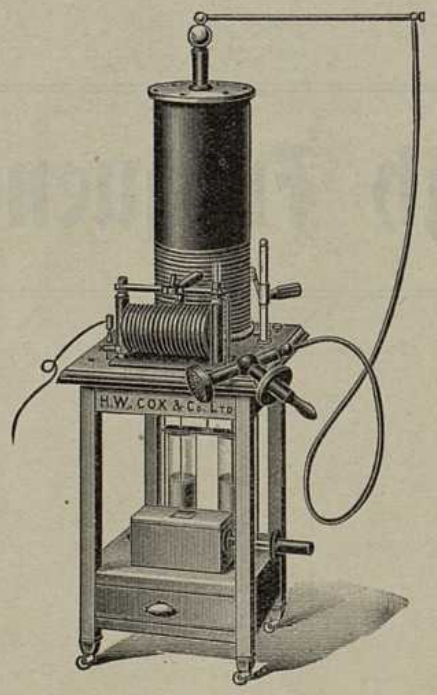


FIG. 73.

Since the introduction of the X-Rays, nothing has attracted the attention of the medical profession so much as the results obtained by the application of High Frequency currents, in the treatment of some diseases. As a great number of medical men have an X-Ray apparatus, and the extra cost of the D'Arsonval and Oudin Resonators for producing High Frequency currents with the proper electrodes is small, there is little doubt that many medical men will add this to their present apparatus.

Briefly, the High Frequency apparatus consists of two Resonators, two Leyden Jars, and a Spark Gap, which is now practically silent. The current from the Induction Coil is conducted to the inner coatings of the Leyden Jars, which are connected to an adjustable Spark Gap. The outer coatings are connected to a solenoid of stout copper wire. When the Jars are charged to a certain potential, they discharge across the Spark Gap and oscillations of extreme frequency are set up in either or both of the solenoids, and these oscillations may be utilised by the attachment of conductors to either of the solenoids. The effleuve can be increased or diminished by cutting out more or less of the wires in the solenoids, by increasing or diminishing the size of the Spark Gap, and by increasing the amount of current in the Coil.

The currents may be administered in the following manners:—

1. *Auto-Conduction.* In this case the solenoid must be large enough to envelope the patient, but actual contact must not take place at any point. Currents are induced into the patient. This can be demonstrated by sparks being drawn from any part of him. The patient is saturated through being in the magnetic field.

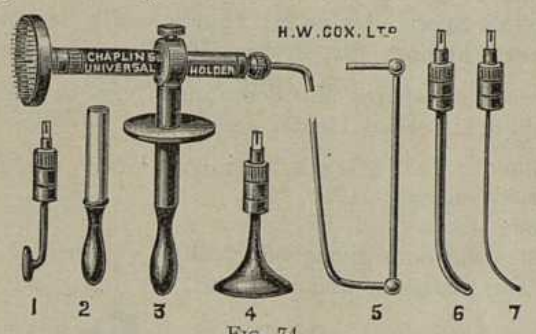


FIG. 74.

ELECTRODES.

2. *Auto-Condensation.* The patient is placed upon a couch, which has a large sheet of metal underneath the insulated cushions, the metal sheet being attached to one end of the solenoid. This forms one armature of a condenser. The patient, when holding in his hands electrodes which are connected to the other end of the solenoid, forms the other armature.

3. *Monopolar.* From the free end of the large resonator a brush discharge or effleuve, similar to, but of much greater intensity than that generated by the Static Machine, is obtained. This effleuve is quite painless, and is directed by means of a special electrode to the particular part of the patient requiring treatment. It can be used if necessary when the patient is undergoing Auto-Condensation on the couch, and in cases where it is necessary, a suitable electrode can be used for localising the effleuve to any special part.

4. *Bi-polar.* By using electrodes which can be applied to any particular part of the body, and of such shape and size as the particular case demands.

Physiologically, High Frequency currents have been proved by D'Arsonval and many other Continental observers to increase elimination of waste products by the kidneys, etc., to increase the CO_2 given off by the lungs, to increase the body heat and to increase the general nutrition, etc.

Certain "Toxins" lose their power and become innocuous, and Tubercle Bacilli seem to be attenuated by overgrowth.

It would be quite impossible in the small space allowed for explanatory purposes in a catalogue to give in any appreciable manner the various diseases in which High Frequency currents have been found useful.

General Methods 1 and 2 in Gout, Rheumatism, Rheumatic Gout, Rheumatoid Arthritis, Diabetes Tuberculosis, Pulmonary and Articular.

Local 3 and 4 in Lupus and other skin affections, Sciatica, Neuralgia, Hemorrhoids, etc. Rodent Ulcer and Malignant Growths (to allay pain).

The price of the High Frequency Apparatus as Fig. 73 is	£12	0	0
Price of Apparatus as Fig. 75	10	0	0
Mr. A. Chaplin's Special Universal Handle, with set of Electrodes, Tubing, etc., as Fig. 74	4	10	0

Electrodes of all shapes and descriptions can be supplied for use with the Chaplin Universal Holder. Prices:—

Glass, with Fluid	7/6
Glass (exhausted vacuum)	8/6
Metal Electrodes for rectum, etc.	4/6
Glass, exhausted vacuum, giving off X-Rays	12/6
Flat Rubber Electrodes for abdomen, etc.	10/6

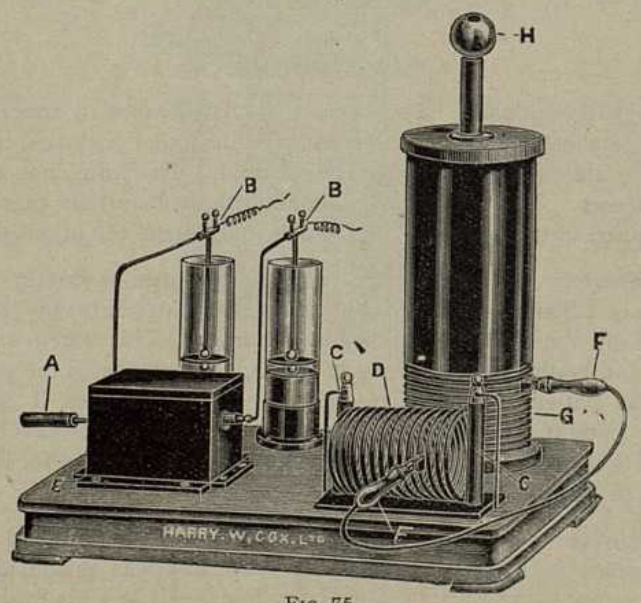


Fig. 75.

High Frequency Couch.

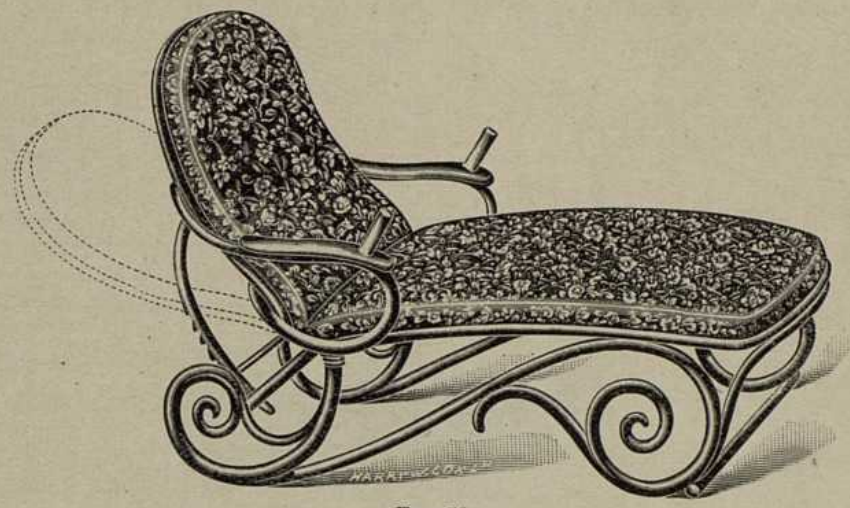


Fig. 76.

For Auto-Condensation. Properly insulated in every way; electro-plated handles and fittings complete.

PRICE £7 0 0

A smaller Couch on the principle of the arm-chair can be supplied.

PRICE £5 5 0

High Frequency Miliampere Meter, English-made.

PRICE £4 10 0

As the pattern and connections of the High Frequency apparatus are, owing to improvements in construction, being frequently changed, we find it will be useless to give instructions for working it in our catalogue, but full instructions will be sent out with each set of apparatus.

Installations have been placed in most of the large hospitals, and a great number of the leading medical men are in possession of the apparatus.

Step-up Transformer,

For use on the Alternating Mains.

This apparatus will be found useful in houses where the alternating current is installed and it is wished to use the High Frequency Apparatus, as in this case the Transformer can be used instead of the Induction Coil.

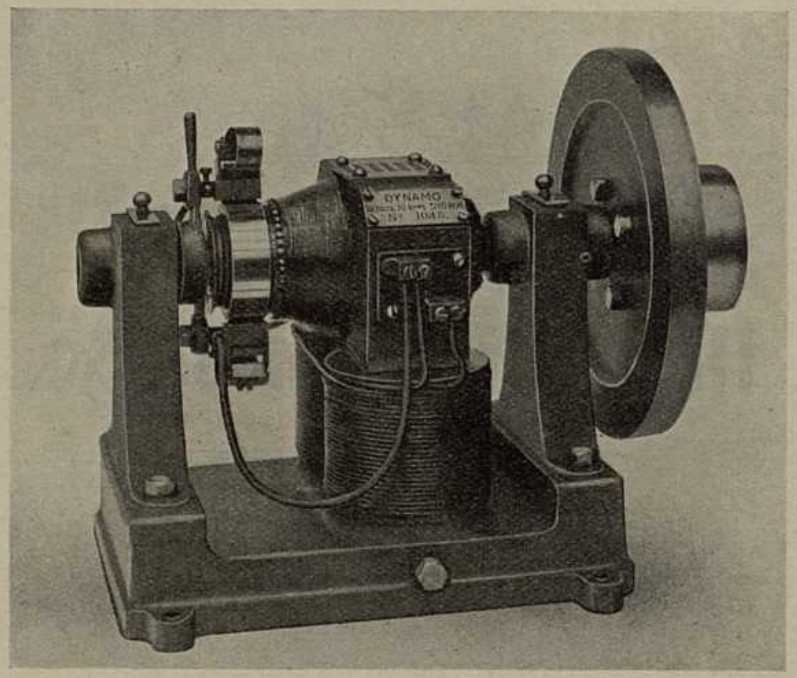
PRICE ... ... £6 6 0.

N.B. It is important that the wires of the Step-up Transformer are not touched, as it is most dangerous to do so.

Dynamos,
Motor Dynamos, &c.

Dynamos for Charging Accumulators, &c.

These small dynamos are especially designed for charging accumulators, and are highly efficient, being constructed in every detail on the lines of the larger dynamos for electric lighting purposes.



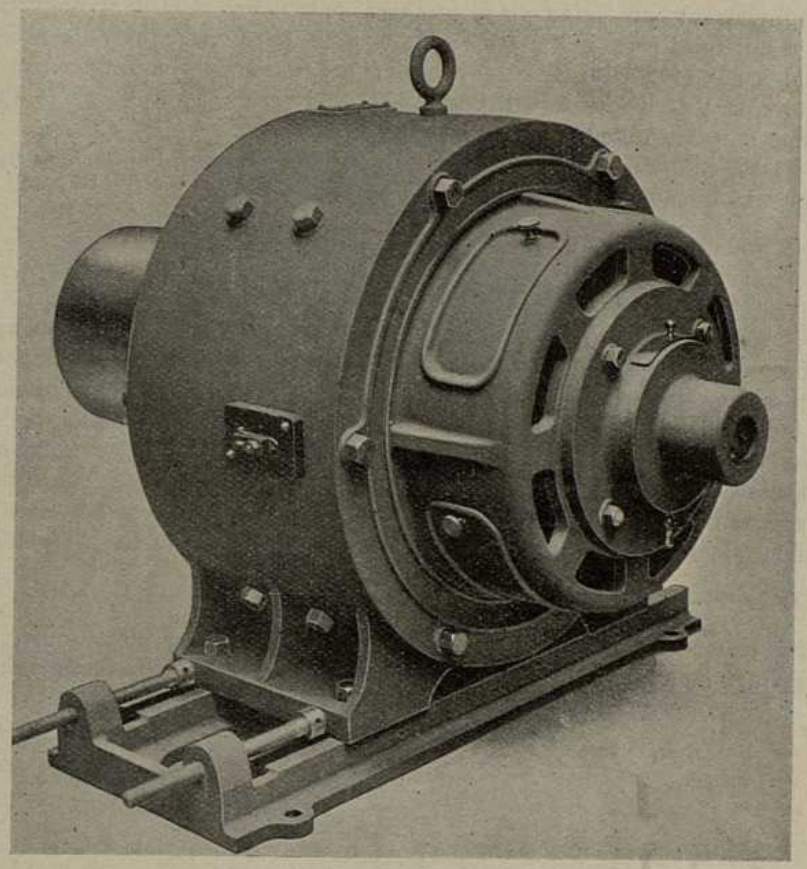
OPEN TYPE.

50 volts 10 amps. at 2,200 revolutions a minute, requiring a gas, oil, or petrol engine of 1¼ to 1½ brake horse power to work it.

PRICE.

DYNAMO	**£18 0 0**
Slide Rails for tightening Belt	**0 18 0**
Fly-wheel Pulley, if required	**1 2 0**

Dynamos for Charging Accumulators, &c.



CLOSED TYPE.

50 volts 10 amps. at 1,200 revolutions a minute, requiring same engine as open type.

PRICE.

DYNAMO	**£21 0 0**
Slide Rails	**0 18 0**
Fly-wheel Pulley, if required	**1 16 0**

As these machines are made on the interchangeable system, duplicate parts can be supplied at short notice.

Cheaper and smaller dynamos can be supplied if desired.

Gas and Oil Engines for running Dynamos.

There are many of these engines on the market, but as every day improvements are being made in their construction, it is impossible to give any fixed price in a catalogue. As a rough guide it may be taken that a gas engine suitable for working a dynamo for charging accumulators, say, of 24 volts, will cost about **£21**, and an oil engine of the same capacity about **£30**.

We will always quote for the most suitable engine of either description which may at the time be on the market.

Motor Generators.

As the ordinary electric supply from the local authorities is always of too high a voltage for charging accumulators, and the large resistances for cutting it down are very wasteful, it is sometimes convenient to employ a motor generator for the purpose of charging them, the motor being worked from the mains of the electric supply, and it in turn working the generator to charge the accumulators at the required voltage. The initial expense is large, but it repays itself by the amount of current that is saved when only a small number of accumulators have to be charged at a time.

PRICE

of a motor and dynamo for working off alternating or direct current, mounted on a cast-iron base, and connected by a flexible coupling with a resistance for regulating the charging current.

Open Type	...	...	...	...	**£39 0 0**
Closed ,,	...	...	...	...	**43 0 0**

Rotary Converters.

These machines have not the flexibility as regards output of current of the motor generators mentioned before, but will be found satisfactory when the secondary voltage is a fixed quantity, as, for instance, charging accumulators.

PRICE .... £21 10 0.

When ordering either of the foregoing kindly state the voltage and amperage required.

Starting Switches.

In starting a motor generator or rotary converter, a starting switch with a no voltage safety release must be used.

PRICE of Starter .... £1 10 0.

Practical Hints to Beginners.

Appendices.

INTRODUCTORY.

PRACTICAL HINTS TO BEGINNERS.

Being a Simple Explanation of the X-Ray Apparatus, with instructions how to set about work.

THE NOVICE should begin by making himself familiar with the various parts of his apparatus; we propose, therefore, while avoiding, as far as it is possible to do so, all electrical technicalities, to explain shortly the principal features and functions of the accumulator, coil, vacuum tube, &c., &c.

So far as at present known the X-Rays cannot be generated without electricity or radium, so that the operator's first step is to possess himself of a supply of electrical energy to produce the required current. We shall assume that he has selected as his source of electrical energy one of the many forms of primary battery, or, better still, a properly charged secondary battery. Examples of these in their various forms are to be found on page 46.

We shall make no attempt to describe the interior of these batteries, or how or why they generate or accumulate, as the case may be, electrical energy, all of which can be learnt from any elementary manual of electricity; we would merely point out that every battery has two terminals, one for the flow and the other for the return of the current, and although the expressions *positive* and *negative* are more popular than scientific, they may be conveniently applied to these terminals. The operator must be careful that the positive and negative terminals do not by accident become directly connected with each other through any metallic substance being placed in contact with both. The result would be what is called a "short circuit," which may easily render the accumulator useless.

The next question is how the electrical energy with which the operator has supplied himself is to be made to produce the X-Rays.

If you were to attempt to pass the current direct through the vacuum tube by connecting the positive and negative terminals of the

accumulator to the corresponding terminals of the tube, you would find that no rays would be produced, the reason being that the force or pressure of the current, commonly called the E.M.F., or electro-motive force, would be insufficient. To explain this let us take an analogy. Suppose, instead of an accumulator charged with electricity with which you desire to illuminate the tube, you have a cistern full of water with which you want to produce a fountain. If you place your cistern on a level with the fountain and turn on the taps, the water will trickle away, but no spray will result. Why? Because you have not sufficient force or pressure. But if you take the same cistern to the top of the house, or employ some pumping contrivance, the pressure or force of the current of water will be increased, and the fountain will play.

We do not suggest that the foregoing is by any means a perfect analogy, but the reader will understand that, in order to intensify the force of the current of electricity, supplied by his battery or accumulator, some contrivance is necessary, and in practice we find that the best contrivance is what is known as an induction coil, commonly called, after the inventor, a Ruhmkorff coil.

For a detailed explanation of the principles of the Ruhmkorff coil, we must refer the beginner to his encyclopædia, or to one of the numerous elementary works upon electricity; we shall confine ourselves to explaining that its construction is based upon certain principles or laws of electricity, discovered by Faraday seventy years ago. The first of these principles is that where you have two entirely separate and distinct circuits placed near to each other, but not in contact, you will, by exciting an electric current in one of them, instantly *induce*, or, in other words, *produce by induction*, an electric current *in the opposite direction* in the other. The original current is called the *primary* current, and the circuit in which it is produced is called the primary circuit, while the induced current is called the *secondary* current, and the circuit in which it is induced is called the secondary circuit.

Similarly, if the current in the primary circuit is suddenly interrupted, a secondary current will be momentarily induced in the secondary circuit, but in this case, *in the same direction* as the primary current. It follows that if you alternately open and close the primary circuit with great rapidity, thus alternately exciting and interrupting its current, you will induce, in the secondary circuit, a current which is continually changing its direction; in other words, what is called an alternating current.

The second principle is that the rapid movement of a magnet in proximity to a conductor or of a conductor in proximity to a magnet, will excite an electric current in such conductor.

The third principle is that an ordinary bar of soft iron, which is for

practical purposes non-magnetic, may be converted into a very powerful magnet—termed an *electro-magnet*—by being placed in the neighbourhood of an electric current, and that the magnetism so produced will last so long as the current continues.

Now, in the centre of the Ruhmkorff coil is a core or bar of soft iron, round which the primary wire is wound, the effect of which is that directly an electric current is excited in this circuit the iron core becomes magnetised. The core is, in fact, instantly converted into an electro-magnet emitting lines of magnetic influence, and the immediate sphere through which these lines of magnetic influence pass is called the magnetic field.

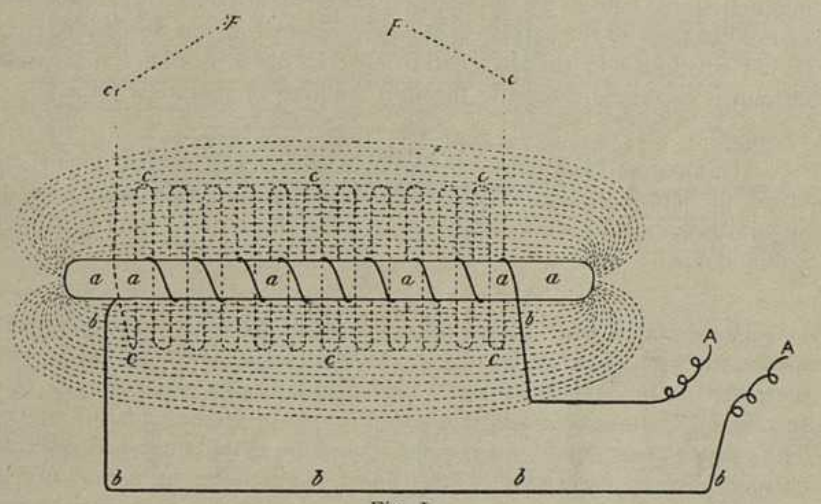


Fig. I.

The secondary coil, which consists of many thousands of yards of very fine insulated copper wire, is wound round the core and primary circuit in such a manner that it is continually passing through the magnetic field.

Fig. I., while by no means showing the detailed construction, will serve to illustrate the principle upon which the primary and secondary circuits are respectively wound. (*a a*) represents the iron core. The thick line marked (*b b*) represents the primary circuit, the positive (+) and negative (−) terminals of which (*A A*) would be connected to the corresponding terminals of the battery. It will be seen that this primary circuit (*b b*) is wound round the core (*a a*) so that immediately the current from the accumulator is turned on the core will be magnetised.

The dotted line (*c c*) represents the secondary circuit, the positive (+) and negative (−) terminals of which (*F F*) would be connected to the vacuum tube as hereinafter described. Owing to the proximity of this

secondary circuit (*c c*) to the primary circuit (*b b*) the instant the primary current is excited in (*b b*) a secondary current *in the opposite direction* is induced in (*c c*), while the instant the primary circuit (*b b*) is broken or opened a secondary current *in the same direction* is induced in the secondary circuit (*c c*).

In order to make the diagram plain, the secondary circuit is shown as passing only twelve times round the primary circuit and core, but in actual practice this secondary circuit is several miles in length, and is wound many thousands of times round both, in the form of a bobbin.

The horizontal dotted lines in Fig. I. represent the *invisible* lines of magnetic force caused by the magnetisation of the core (*a a*), and it will be noticed that by the arrangement above described, the secondary circuit (*c c*) is enveloped in this magnetic field; in other words, the secondary current is continually passing through the lines of magnetic force.

The foregoing is a mere outline of the principle of the construction of an induction coil, and the beginner will naturally ask how this apparatus operates to intensify the force of the current supplied by the accumulator?

The actual E.M.F. of the primary circuit remains in all probability unaltered, but the E.M.F. of the resulting secondary current is vastly increased from several causes. One cause is the great length of the secondary circuit, necessitating an enormous number of turns or coils. The greater the number of coils, the more frequently does the secondary current have to pass through the lines of magnetic influence, and the more often it passes through this magnetic field the more intense becomes the pressure or voltage.

Another cause is a contrivance by which the primary circuit is opened and closed, and the primary current consequently interrupted, with great frequency and rapidity, thus constantly magnetising and demagnetising the core. We have already explained that the rapid movement of a magnet in proximity to a conductor will excite a current in such conductor. In the Ruhmkorff coil you are, by repeatedly interrupting the primary circuit, constantly magnetising and demagnetising the core; in other words, constantly producing a magnet in proximity to the secondary circuit, and immediately taking it away, an operation practically tantamount to the rapid movement of a magnet in proximity to the secondary circuit, the result being to excite a current in the secondary circuit.

It will thus be seen that the secondary current is not only intensified by its constant passage through the lines of magnetic force, but also by the rapid magnetisation and demagnetisation of the iron core. It must

also be remembered that the continual making and breaking of the primary current causes the secondary current to be constantly changing its direction, so that it is further intensified by being converted into an alternating current.

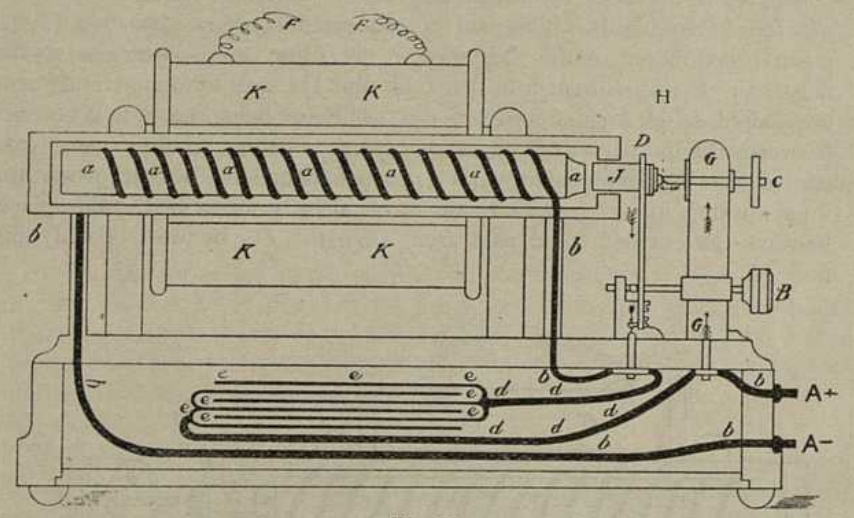


Fig. II.

The device by which the primary current is thus interrupted is shown at Figs. II. and III. In Fig. II. the primary circuit is closed. The current passes from the positive terminal (+) up the metal pillar (*G*), by way of the platinum points (*H*) to the hammer or contact breaker (*J*), down the spring of the hammer (*D*), and thence by way of the primary circuit (*b b*), round the core (*a a*), and back to the negative terminal (−).

A loop (*d d*) is shown which goes off to the condenser (*e e*), but if this is followed it will be perceived that the two parts of the condenser are not in contact, so that the current cannot circulate through this loop, the functions of which are described later.

Now, the moment the current is turned on, the core (*a a*) is magnetised, and, as a natural consequence, the hammer or contact-breaker (*J*) is drawn by magnetic attraction towards it. The immediate effect of this is to break the contact, or open the circuit at the platinum points (*H*), as shown in Fig. III. The result of thus breaking or opening the primary circuit is to demagnetise the core (*a a*), so that the hammer (*J*) ceases to be attracted, and is caused by the spring (*D*) to fly back to its original position, as shown in Fig. II., when the process is automatically repeated; the primary current being thus interrupted and the circuit opened and closed with wonderful rapidity.

It only remains to draw attention to the loop (*d d*) leading to the condenser. The reader will observe that this loop is not strictly a portion

of the primary circuit proper, but a kind of lateral extension of that circuit from the two pillars (*G* and *D*) of the contact breaker. The condenser itself (*e e*), to which this loop leads, consists of several thin layers of tinfoil placed in the base or stand under the coil. Each layer is connected to the next layer but one, but is carefully insulated from its next-door neighbour. One set of connected layers is attached to the positive conductor of the loop, while the other set is attached to the negative. It will be seen from Figs. II. and III. that by this arrangement this loop does not form a complete circuit, there being no actual contact between the positive and negative layers; whereas, if they were connected, the primary circuit would not be opened or broken when the interruptions at (*H*), which we have already described, take place, because the current could pass from (*G*) to (*D*) by way of (*d d*) and (*e e*).

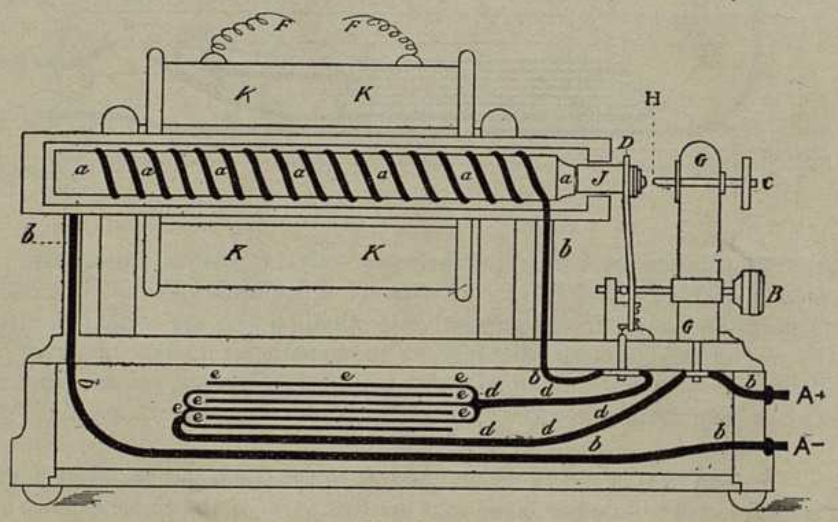


Fig. III.

We have already explained that the making and breaking of the primary circuit induces alternate currents in the secondary circuit, and it is also a fact that the breaking of the primary circuit will momentarily produce by induction a slight current in the same direction in itself—a phenomenon which is called self-induction. Now, the function of the condenser is to absorb this self-induced current which is formed in the primary circuit at the moment when such circuit is broken at (*H*). When this break occurs, the current seeking a passage rushes to the condenser by way of the loop (*d d*), only to find that there is no contact between the positive and negative sheets of tinfoil which compose the condenser. The electricity thus accumulated by the condenser is discharged a moment later through the primary coil, thus creating a current in the opposite direction to the battery current, and consequently demagnetising the core.

As the induced current is due to the change in the magnetisation of the core, this demagnetising current greatly adds to the efficiency of the coil.

Further, by thus absorbing the current, the condenser reduces the liability of the primary current to "arc" or spark across the space between the platinum points at (*H*) when the contact is broken.

The important part which this condenser plays in intensifying the secondary current will be appreciated when we inform the reader that a 12-in. spark coil without a condenser will barely give a spark of 2 inches in length.

To such an extent is the intensity of the secondary current increased by the various devices which we have described, that if the secondary circuit is left open between the terminals (*F F*) the current will be forced across the intervening space, and a continuous stream of sparks, like miniature forked lightning, will pass from one terminal to the other.

The space between (*F*) and (*F*) over which this stream of sparks will travel depends, of course, upon the size of the coil, but the ordinary coils used in practical radiography will throw a stream of sparks from 8 to 12 inches in length.

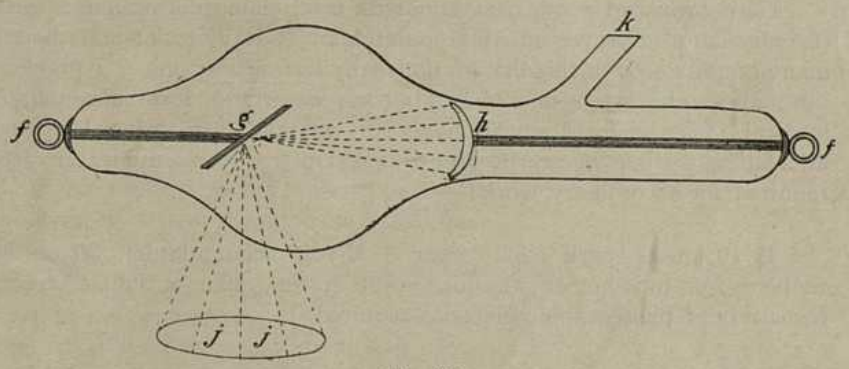


Fig. IV.

Having now explained how the current supplied by the accumulator may be intensified to the necessary degree, we will pass to the vacuum, or, as it is sometimes called—after Sir William Crookes, one of its discoverers—the Crookes' tube. This may be described as the lamp in which the X Rays are produced. It consists of a highly-exhausted glass tube or bulb (*see* Fig. IV.), the shape of which varies. At each end will be found a metal ring or wire hook (*f f*) by which the tube is connected to the terminals (*F F*) of the secondary current. These wires pass through the glass internally, but are not connected to each other inside the tube. They each terminate with a disc or plate made of

aluminium and other metals, and called an electrode, one of which, the positive, is usually flat, and is called the anode (*g*), while the other, the negative, is usually concave, and is called the cathode (*h*). The small exhaust tube (*k*) generally left on the tube is merely the result of the process of manufacture.

We have already shown that if the secondary circuit is left open, as in Fig. I., a stream of sparks will flow between the terminals (*F F*), but when these terminals are connected to a vacuum tube, instead of a stream of sparks passing between the anode and the cathode, nothing is seen to pass, but the tube becomes fluorescent, and is filled with a vivid apple-green or pale blue light.

The concave shape of the cathode causes the rays to converge to a focus, so that they strike against the platinum face of the anode, which is placed at such an angle that the rays are deflected and thrown upon the object (*j j*) which is to be examined or radiographed (*see* Fig. IV.).

We trust that the foregoing brief and, we fear, very imperfect sketch, will furnish the beginner with a rough idea of the nature of his apparatus. We now propose to offer him a few practical hints as to how he should set about work as a radiographer.

He is furnished in our catalogue with up-to-date information as to all the very latest improvements in apparatus for X-Ray work; and though many of the goods in this list are not really *necessary* for general practice, but may be almost considered as luxuries, we would, for the benefit of medical men and others who have not yet taken up this useful and interesting work, suggest the following list of really essential apparatus required for all ordinary work:—

1 10 to 14-spark coil; 2 or 3 6-volt accumulators, 30 to 60 ampères; 1 tube-holder; 1 fluorescent screen, 12in. × 9in.; 2 record focus tubes; photographic plates as required.

With the above apparatus and a little practice, any ordinary X-Ray work can be accomplished.

In Figs. II. and III. we give a rough idea of the interior of a Ruhmkorff coil, the external outline of which we now show in Fig. V.

The screws (*A A*) in Fig. V. are the terminals of the primary circuit, and correspond with (*A A*) in Fig. II., though placed in a different position. The discharging pillars (*F F*) in Fig. V. correspond with the terminals of the secondary circuit (*F F*) in Fig. II., while the iron core (*a a*, Fig. I.) surrounded by the primary and secondary coils is in Fig. V. hidden, being encased in vulcanite in the form of a large bobbin.

The operator's first step is to connect the coil with the battery. To do this two wires, which should be covered with insulating material, are necessary (one from the positive (+) and one from the negative (—) pole of the battery). These wires must be connected with each of the two

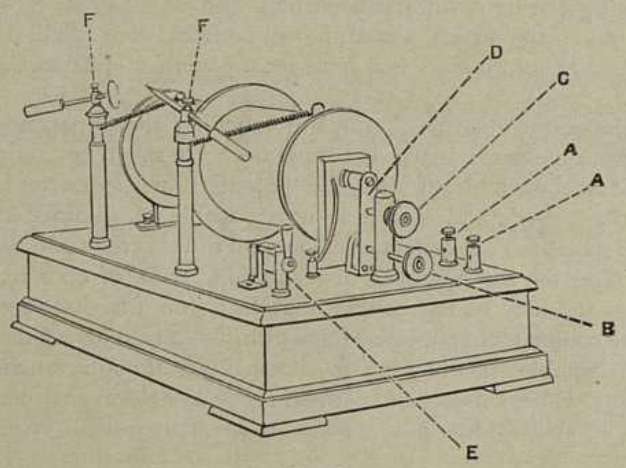


Fig. V.

Diagram showing the External parts of a Ruhmkorff Coil.

terminals (*A A*) on the base of the coil. Before attaching these be sure that the switch (*E*) is turned off. This switch, which is sometimes called the "commutator," or "current reverser," fulfils a dual purpose. When standing upright, as shown in Fig. V., it entirely cuts off the primary current and prevents its passing from the battery to the coil. When turned down to the right it allows the current to pass in one direction, and when turned down to the left it reverses the current and allows it to pass in the opposite direction.

Having satisfied himself that the commutator is upright and the current thus cut off, the operator will place the Crookes' tube in position He will first fix it in the tube-holder (*see* page 30), and then, by means of two wires, which should certainly be covered with insulating material, connect the terminals of the tube (*ff*, Fig. IV.) to the discharging pillar (*F F*, Fig. V.), the latter being the terminals of the secondary circuit.

He should next turn the tension screw (*B*) to the right, thus taking the pressure of the spring (*D*) off the contact screw (*C*), so that only a little current will pass through the contacts (*H*) when the commutator (*E*) is first turned on. If the connections have been properly made, so that the current passes through the tube *in the proper direction*, the latter should glow with a fluorescent light of an apple-green tint, excepting behind the platinum anode, which will cast a slight shadow. It is of importance, however, to make sure that the current *is* passing in the proper

direction, *i.e.*, from the anode to the cathode, and not *vice versâ*. The operator can obviously connect either terminal (*ff*) of the tube to either of the discharging pillars (*F F*), but he must alter the direction of the current accordingly by means of the commutator (*E*). He will have no difficulty in discerning when the direction of the current is wrong. The fluorescent green light will not be strong, and will appear to change its position, and if the screen is used, it will be found that it will not fluoresce properly, and that the rays will have little or no penetration.

The operator must be cautious in touching the apparatus while the current from the accumulator is turned on. He must not forget that by means of the Ruhmkorff coil the potential of the current has been enormously raised, and that it is now capable of administering a considerable shock. The contact, tension, and other screws and parts usually handled, are, for the purposes of insulation, made of ebonite, vulcanite, and so on, and may be touched without fear, but the discharging pillars (*F F*), the conductors connected therewith, the terminals of the tube, &c., &c., are capable of inflicting a shock, even though touched by one hand only; while, should one of these parts be held in each hand, so that a circuit is made through the body, a far more severe concussion wi' be felt.

When the operator has ascertained that the current is passing in the proper direction, the tension screw (*B*) should be turned *very* slowly to the left. This puts more pressure on the contacts (*H*), and allows a freer passage for the current, and the effect should be to cause the tube to become brighter. Should the tube flicker much, it may either be owing to the uneven surface of the platinum contacts (*H*), or to the high vacuum of the tube. As a rule, the platinum will, if left undisturbed, burn itself level. For this reason we advise the beginner not to alter the *contact* screw (*C*) more than absolutely necessary, as most of the adjustment can be done by the *tension* screw (*B*). Also see Appendix II. It may, however, be necessary to pass a fine file over the platinums from time to time.

If, after a few minutes' working the tube still continues to flicker, it should be warmed in the flame of a spirit lamp, when it will be found to run more evenly. Sometimes the operator will find that the tube, while apparently fluorescing well, has little or no penetration, and throws a very imperfect image on the screen, also that his radiographs will require very long exposures. This is usually due to the vacuum being too low, and the defect can nearly always be remedied by working the tube for from 30 seconds to a minute with the current reversed, or it may be caused by enough current not being sent through the coil.

In purchasing a tube, it is well to state what length of spark the coil gives, we then send one that will run smoothly at first; but it must be borne in mind the more a tube is worked the higher becomes the vacuum, and though tubes improve with working for a time, it will be found that in consequence of much use they will often require to be heated with a

spirit lamp. This can be done while the current is passing, though the operator must keep the lamp at a fair distance from the tube, or he may get a shock.

Our insulated lamp-holders are designed as a protection from shocks in these cases.

Another indication of the vacuum being too high is the passing of sparks outside the tube. When this occurs, the current should be turned off at once and the tube warmed, otherwise a spark may perforate the tube and render it useless.

Other methods of lowering the vacuum of tubes that have become useless may be resorted to with more or less success.

Some operators place them in a hot oven overnight until the following morning, and the writer has heard of tubes being weighted and boiled in oil for several hours. Another method is to gum a strip of tinfoil about ½-in. wide around the tube, almost level with the cathode, and to gum another strip from this to the cathode terminal end of the tube. This will be found successful until the vacuum again becomes too high. Another way is to heat the tube over a Bünsen burner very gradually until the glass becomes soft, and a slight indent occurs. The tube must then be *instantly* withdrawn, otherewise the air will be sucked into it, rendering it useless. It must then be put aside to cool gradually, when it may be tested again. Should no X-Rays be omitted, and the tube fluoresce blue, it must be worked for several minutes, during which time the current should be reversed now and again, when it will gradually begin to fluoresce as usual, and will probably be almost as good as a new one. The heating operation is always attended with risk of destruction to the tube, but with care the vacua of half-dozen can thus be lowered in about ten minutes.

Finally a point is reached when even the heating of a flame will not reduce the resistance of the tube; it should then be laid aside for a few weeks or months, when it may be tested again. In no case should these over-exhausted tubes be destroyed, as they will be found most useful for therapeutic work.

Tubes are now made with a small vacuum regulating bulb "added to the main tube." This bulb contains suitable substance, which has the power of lowering the resistance of the tube when a current is passed through it. The special advantage of these tubes is that the same tube can be worked from a 6-in. or 12-in. spark coil. We give a description of this tube on page 25.

When the vacuum of a tube is low, the bones show intensely black on the fluorescent screen, whereas when the vacuum is increased

there is greater penetration, more detail is shown in the bones, and the tissue entirely disappears.

The anode is generally faced with platinum, backed by a thick piece of aluminium. The fact of the anode becoming red-hot does not matter so long as it is not perforated.

Tubes will be found to give excellent results that spark between the discharging points of the coil at all distances up to 4 to 6 inches, when the tube is also working on the coil. This is the best means of informing us what tube you require; for instance, with a very low tube the current will pass between the discharging points when they are about 1 inch apart and not at a greater distance; as the vacuum goes up the distance at which it will pass between these points increases, until eventually it become so high that the current will fly round the tube instead of passing through it; this is also called a "hard" tube.

If a special tube is required it is only necessary to tell us at what distance the sparking is to cease.

Some tubes will be found to fluoresce red instead of green; this is due to peculiar glass from which the tube is made. There is no particular advantage in them, but we can supply them if required.

When the operator has succeeded in making his tube fluoresce satisfactorily, he can proceed either to examine or take a radiograph of his subject. It is best to first examine the part to be radiographed by means of the fluorescent screen. This consists of a chemically-prepared sheet of vellum, or other suitable material in a frame, one side of which is coated with Barium Platino-cyanide. The screen must not be subjected to unnecessary heat, and the coated side must not be scratched or pressed, or the utility of the screen will be impaired. To examine the bones of the hand, for instance, the hand should be held near the tube in such a position that the rays reflected from the anode will play upon it as nearly as possible at right angles. The actual rays are invisible, but, by observing the angle of the anode or platinum deflector, and with the aid of the screen, the operator will be able to judge where the hand should be held. For screen or radiograph work, the tube will generally give the best results when the anode is nearly parallel with the object to be viewed or radiographed. The fluorescent screen should next be placed against the hand on the opposite side to that on which the tube is, so that the hand is between the tube and the screen, and the screen between the hand and the operator. The prepared side of the screen shonld be held towards the operator. The rays will then penetrate the hand, casting a shadow of the bones upon the screen. The part examined should always be against the screen and from 3 to 6 inches from the tube. Should the operator have already practised photography, his experience will be of considerable

assistance to him. He can either use ordinary photographic dry plates, films, Bromide paper, or any of the films or papers specially prepared for X-Ray work. By putting more than one film or paper in the envelope, several negatives may be obtained from a single exposure, but in either case his first care should be to avoid distortion of the image, by getting the plate or sensitised paper into the proper position, *i.e*, in such a position that they present an absolutely flat surface to the rays. This is a matter which depends principally upon the proper adjustment of the focus tube, which can be made to throw the rays in almost any direction.

The plate—properly protected, of course, from ordinary light—should be laid flat upon the table, with the film upwards, and care should be taken that there are no joints, folds, or irregularities in the envelope covering its upper side. The hand, or whatever part of the body is to be radiographed, should then be laid flat upon the plate, and the tube adjusted so as to throw the rays upon it. Care must, of course, be taken that neither the tube, nor the patient, nor the plate is disturbed during the exposure.

For the head, shoulder or thigh the tube is generally about 14 to 16 inches from the plate.

For the hands, feet, arms, etc., from 12 to 16 inches. It will be understood that the further the tube is from the plate, the more correct will be the definition, but the exposure will be longer.

To radiograph the bones in the hand the exposure from a coil giving, say, a 10-in. spark, should be from five to ten seconds. An ankle generally takes from twenty to thirty seconds; the thorax from thirty to sixty seconds; the pelvis about one minute. These exposures are when using the Mackenzie-Davidson Break; when working with the platinum interruptor double the time will be required. A great deal depends upon the condition of the tube and the amount of current used. Any ordinary photographic plates may be used. We have obtained excellent results with:

Thomas's Special X-Ray Plates. Cadett's Lightning.
Lumiere's X-Ray Plates. Eastman's and Barnett's Plates.
Edwards' Cathodal Plates.

To obtain good definitions the tube must not be brought too near the object to be radiographed, especially when radiographing soft substances, such as calculus, etc.

The developers recommended with the plates or films will, in most cases, be found satisfactory; but in order to get good contrast, the developer should be weak. One great fault is the tendency to under-develop. There is no reason why development should not be continued for thirty to forty minutes.

The dry plates and sensitised paper not actually in use must not be brought into the same room as the apparatus, unless carefully protected in a lead-lined box, as, owing to the penetrating nature of the rays, they would soon be rendered useless, even though apparently beyond the influence of the tube.

We strongly recommend the use of an ampere meter when taking radiographs, as it is most essential that an amperage of seven to ten amperes is put through the coil.

We have now taken the reader shortly, step by step, through the process of taking a radiograph, and we venture to hope that the explanations and hints we have given may be of service to him, and enable him to make a satisfactory beginning as a skiographer. When once he has done so, we have little doubt that he will find radiology so interesting and useful that he will seek further information, and we would recommend him to study Dr. Walsh's well-known book, "The Röntgen Rays in Medical Work." He will also find it advantageous to join the Röntgen Society, which publishes a special journal furnishing the latest information on X-Ray work. We shall be pleased to supply the necessary information to enable any of our readers to do this.

Appendix I.

Instructions for Connecting and Working Cox's Base and Portable X Ray Coils.

When Working from the Platinum Interruptor.

Nos. 1 and 2 refer only to the Portable Coil.

PORTABLE COIL.

1. Place the discharging pillars (which are fixed in lid of coil case) into the sockets on top of coil, and fit the two discharging rods into the tops of these pillars, the points opposite to each other and 4 inches to 6 inches apart.
2. Screw the tube holder into the threaded hole on the top of the coil.
3. Secure the tube (near the cathode terminal) in the tube holder.
4. Connect the discharging pillars with the anode and cathode terminals of the tube, by means of two pieces of insulated wire (ordinary electric bell wire will answer). The wires should not be allowed to touch anything or the current will escape.
5. It is important now to see that the switch, called the commutator (see E, Fig. V., page 91 in Catalogue), is turned off, *i.e.*, the handle should be upright.
6. See that the two or three 6-volt accumulators are connected in series—the red of one accumulator connected to the black of the next, and so on, and connect the two end terminals of the series with the two terminals on coil marked "Battery." Inside the accumulators the positive pole is painted red and the negative black.
7. Turn the tension screw (the lower of the two screws) slightly to the right, and so lighten the pressure of the spring on the contact screw (the upper of the two), and thus only a small amount of current will pass when it is turned on. See also Appendix II.
8. Turn the commutator to the right, and be careful not to touch either the discharging pillars or terminals of tube.

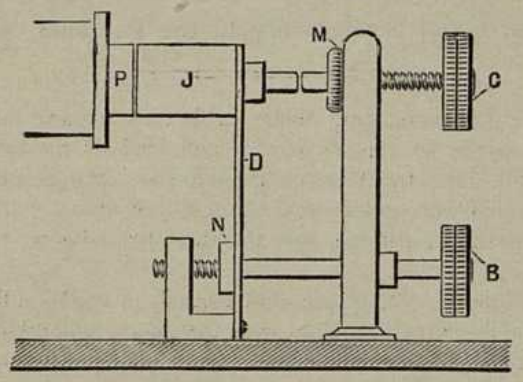
   NOTE.—If the current is passing in the proper direction, *i.e.*, from the anode to cathode, the tube will glow with a fluorescent apple green light, and shadows on the screen will be strong and well defined. Should this not be the case, turn the commutator right over in the other direction, thereby altering the direction of the current, and the tube will fluoresce properly.
9. Turn the tension screw slowly to the left, thus allowing more current to pass, and the tube will become brighter.

   NOTE.—When the hammer is pressed home against the coil there should be a space of about $\frac{1}{32}$ inch between the platinum points, and when the fluorescence in the tube is satisfactory, the contact screw should be fixed by means of the milled nut, near the brass pillar.

For further instructions please peruse "Practical Hints to Beginners," and also Appendix II.

Appendix II.

Instructions for Adjusting the "Cox" Contact Breaker.



How to adjust the Platinum Contacts of the Coil, which, when once adjusted, do not require alteration until the Platinums need filing.

Turn the Tension screw B to the right until the nut N is away from spring D of the Hammer. Loosen the binding nut M and then adjust the contact screw C by turning it so that the two platinum contacts come together. The Hammer J should be pushed over by this screw C until there is a space of about $\frac{1}{32}$-inch between the Hammer J and the primary of the coil P; this will allow a visiting card just to pass through it, *i.e.*, there should be just a small amount of play when the Hammer is moved backwards and forwards with the hand.

Hold the contact screw C with one hand and fasten it in that position by screwing the binding nut M tight home.

Turn the commutator of coil over to allow the current to pass, and turn the Tension Screw B to the left.

As the platinum contacts are pressed together a rumbling noise will be heard, and there will be a slight light at the contacts. Continue turning the Tension screw B to the left and the sparks will fly across the points of the discharging pins.

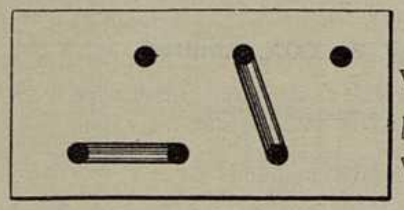
It will be thus seen that by increasing the Tension, *i.e.*, by turning screw B to the left the amount of current (Amperage) passing into the coil is increased, and by decreasing the Tension the Amperage is decreased.

Should the Platinum Contacts at any time stick together at once turn off the current by means of the commutator.

Appendix III.

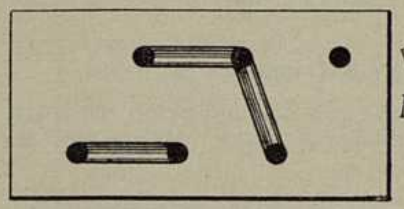
Cox's New Coil with Variable Primaries.

Diagrams showing positions of connecting strips for arranging primary layers when working with various Breaks; also the necessary amount of current and voltage required to obtain full length spark.



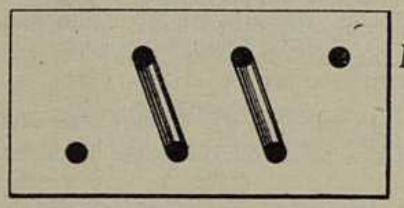
Platinum Break.
Voltage 12. Current 6 to 8 Amperes.

Mackenzie-Davidson Break.
Voltage 24. Current 6 to 10 Amperes.

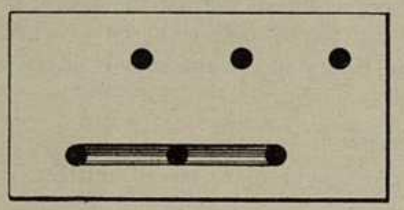


Platinum Break.
Voltage 12. Current 6 to 8 Amperes.

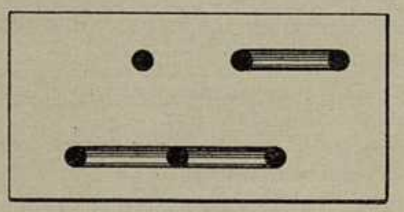
Mackenzie-Davidson Break.
Voltage 18 or 24.
Current 8 to 10 Amperes.



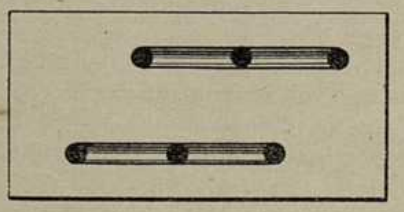
Mackenzie-Davidson Break.
High Voltage 36 to 50.
Current 6 to 8 Amperes.



Electrolytic Break.
Voltage 50 to 100.
Current about **6** Amperes.



Electrolytic Break.
Voltage 36 to 100.
Current about **10** Amperes.



Electrolytic Break.
Voltage 36 to 100.
Current about **15** to **20** Amperes.

Appendix IV.

Brief Instructions for Connecting & Working the Mackenzie-Davidson Mercury Interruptor.

Manufactured by HARRY W. COX, Limited.

1. If the break is worked by a band remove the band.
2. Remove the mahogany top by unscrewing the two brass thumb screws.
3. Remove the iron cover by removing the screws.
4. Pour about 3 lbs. of mercury into the iron pot, and fill up the pot to within 1 in. of top with pure methylated spirits. Water will not suffice.
5. Screw on the iron cover, and see that one copper spring is over the other. It is advisable when screwing the screws home to do first one a little and then the other, and so on, so as to get the top level.

   The motor requires 12 to 18 volts to work it. It can either be driven by a separate battery or as a shunt off the same batteries that are used on the coil.

   The iron ring inside the iron pot is for regulating the height of the mercury; the milled nut on the top of mahogany cover when turned, either raises or lowers the ring, and the mercury is effected accordingly.
6. Replace the mahogany cover and fix band.

   The above explains how to take the break to pieces and put it together again.

   The following is another method of putting the mercury into the iron pot, when it is not required to take the break to pieces:—

   1. Turn the milled head adjusting screw to the right as far as it will go (this raises the iron ring from the bottom of the pot).
   2. Pour about 3 lbs. of mercury through the vent hole into the pot, and then pour in about one pint of best methylated spirits.

   Switch on the motor and see that it runs well, and then switch on the coil.

   Should no results be obtained, turn the screw A to the left; this, by forcing the ring into the mercury, will cause the latter to rise; if sufficient mercury is in the pot the desired results should be obtained; if otherwise, add more mercury, a little at a time, until everything is satisfactory.

Working as a Shunt off the Batteries used to work the Coil.

1. Connect your batteries in series, *i.e.*, the red or positive terminal of one battery is connected to the black or negative terminal of next battery, and so on. The E.M.F. of all the batteries should be at least 24 volts.
2. Connect the end terminals of the series of batteries to the terminals on the coil, which are usually marked "Battery."
3. Connect the terminals, marked "Mercury Break" on the coil, with the terminals marked "Coil" on the mercury break.
4. Connect the terminals marked "Battery" on the mercury break, with either one 12 volt battery or two 6 volt batteries of the series.

   If it is wished, these terminals on the mercury break can be attached to a separate 12 volt battery or to two 6 volt batteries, *i.e.*, when not working off the shunt, but in this case 24 volts will still be advisable to work the coil. (More voltage can be used if required.)

   NOTE.—Should the coil not be provided with *special* terminals for connecting the mercury break, connect the pillar and spring which contain the platinum contacts, with the terminals marked "Coil" on the mercury break.
5. Place a piece of cork between the platinums of the contact breaker on coil (because the mercury break replaces these), and wedge between the hammer and end of coil with another piece of cork, so as to stop vibration.
6. Switch on the motor first of all, and when it has gained a good speed switch on the coil.

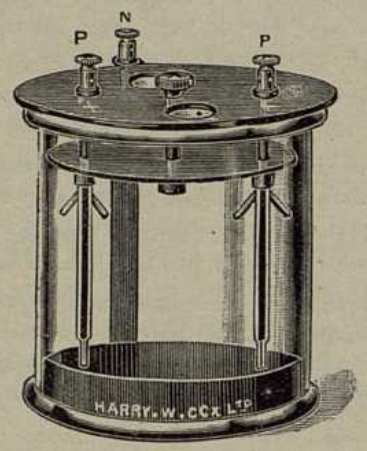
   Should no current pass, switch both off, and add a little mercury through the vent hole. Keep adding mercury until the best results are obtained.
7. The slide on the resistance which regulates the speed of motor should be nearest the switch when first starting.

   The motor should be kept oiled, the brushes and revolving contacts clean, and the brushes must press firmly on contacts. Keep oil away from the revolving contacts. Should the spindle carrying the blade get fixed from being left standing, a little oil will soon loosen it.

   It is important that a little spirit should occasionally be added to that inside the iron pot, so as to make up for evaporation.

   It is advisable to have an ampere meter inserted, in series, with the accumulators and coil.

Appendix V.



Instructions for using the Electrolytic Break.

In order to connect the Electrolytic Break, it must be in series with the primary circuit of the coil, *i.e.*, the direct current supply circuit from which the supply is taken; an alternating current is not suitable for this kind of Break.

The positive wire from the batteries or mains must be connected to the terminals marked thus + on the Break. Great care must be taken to select the positive, for if the negative wire were connected by mistake to this terminal, and the current turned on, the platinum wire would at once be fused, and the Break rendered useless. There is no difficulty in ascertaining which is the positive and which the negative wire by means of a piece of pole-finding paper.

The paper is damped with water, and the ends of the two wires are held against it for a moment, care being taken that they are not in contact. It will be found that the paper will become red where the negative wire has touched it, thus indicating that the other wire is positive.

The negative wire from the batteries or mains must be connected to one of the two terminals on the coil, *i.e.*, the terminals that are used for connecting to the acummulator when working with the ordinary platinum Break. It is immaterial which. The other terminal on the coil must be connected by a wire with the un-connected terminal on the Electrolytic Break that connects with the lead plate.

If desired, a rheostat or an ampére meter, or both, can be placed in the circuit, but a rheostat is not necessary with this Break, as more or less current can be put through the coil by turning the screw at the top of the Break to the right or left, thus exposing more or less, as the case may be, of the platinum wire to the electrolyte.

N.B. We recommend a rheostat when working off the electric light mains, as it gives the operator more control.

The electrolyte consists of sulphuric acid and water, with a S.G. of about 1,200 for 36 to 100 volts, and about half this strength for a 200 volt circuit. It is even better to make the electrolyte weak at first, so that more acid can be added until the best results are obtained, as much depends upon the coil and tube used.

If the coil is specially wound for use with an Electrolytic Break, it will give much better results than a coil that has been wound for working with the ordinary platinum break. For instance, an ordinary 10" spark coil with an Electrolytic Break will seldom give more than a 4" or 6" spark, but if the coil is specially wound it will give a spark of 10" or more.

If the Electrolytic Break is applied to a coil fitted with the ordinary contact-breaker, the two platinums should be brought together, and a piece of cork placed between the end of the coil and the hammer to prevent the latter from vibrating.

Should the Electrolytic Break stop working of itself, all that is necessary is to switch the coil off and on again, when it will again start working. If desired, the platinum break can be allowed to vibrate, but the spark produced will not be quite so rich.

If the tube used is very low, the Break will not work, but on introducing a spark gap in the secondary circuit, it will be found to work satisfactorily. It is best, then, to run the tube the wrong way for a few minutes, when the vacuum will be found to be right, so as to work the same tube without the spark gap. If, on the other hand, the tube is a very high one, the Electrolytic Break will make a loud noise, and will not give good results. It is then necessary to lower the vacuum of the tube, either by warming or any of the usual methods.

The wires used for all connections should be fairly thick, so as not to offer any resistance to the current, care being taken to avoid shocks, and extra care taken to see that the tube and wires are well secured, to prevent injury to the patient.

Two Electrolytic Breaks connected together in series are less liable to stop working than one, but should the Break stop working, there is no fear of the coil being injured, for very little current (only about half an ampére) will pass.

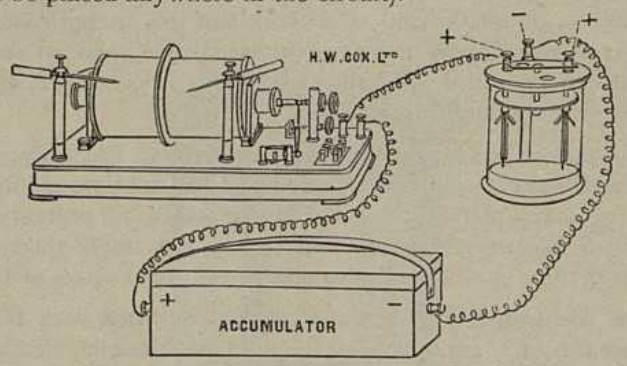
The glass jar should be one-third filled with the electrolyte, which should be quite cool before it is used.

In mixing the electrolyte, the acid should be poured very slowly into the water, as, if the water be poured into the acid, it becomes very hot, and is liable to break the glass.

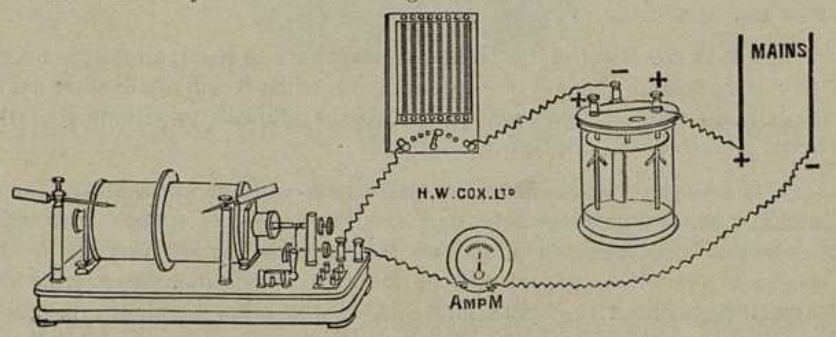
It will be found that on working the Break for any length of time the electrolyte becomes very hot, and tends to stop it working. To prevent this, we supply a special cooler, which can be connected to an ordinary water tap by means of a rubber tube.

We give the following diagrams for connecting up the Electrolytic Break in different ways:—

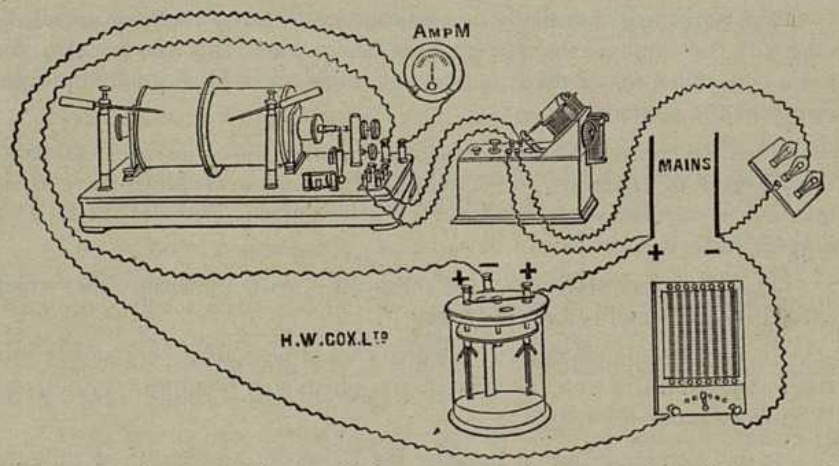
I. Electrolytic Break in series with Accumulators (the Ampere meter can be placed anywhere in the circuit).



II. Electrolytic Break working off the mains.



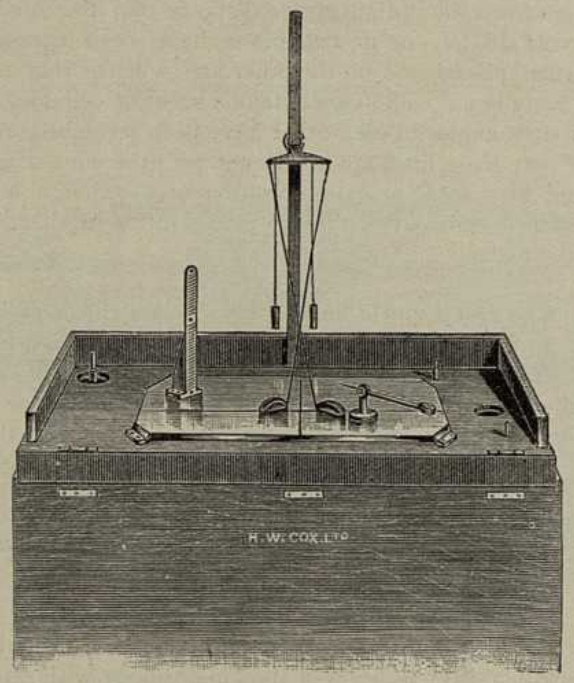
III. Showing connections when working from mains with Electrolytic and mercury interruptor in series with Rheostat and Ampere meter; (in this case the platinums on the coil are separated, but if the Mercury



Interruptor is not used the platinums must be screwed up tight to each other). The diagram also shows a lamp resistance for working the motor of the Mercury Interruptor. The motor can, if desired, be driven from Accumulators.

Appendix VI.

The Mackenzie-Davidson Cross Thread Localiser.



Two exposures must be made either on two separate plates or else two exposures can be made on the one plate in which case the negative will be very dense.

When placing the patient in position on the localising couch or plate changing box, see that by some means the wires which cross each other on either of the foregoing will leave a mark or impression on the patient's skin. This can be done with an ordinary rubber stamp pad.

Before exposing the plates to the Rays adjust the tube in the tube-holder so that the centre of the anode is immediately over or under the point where the wires on the couch or plate changing box cross each other. This can be done by means of a plumb line. Now measure the distance from the anode to the plate, say it is 18 in. Having discovered the approximate locality of the foreign body by means of the screen, place the patient on the couch. Move your tube 3 centimetres in one direction and make an exposure, and then move it 6 centimetres in the opposite direction and make another exposure.

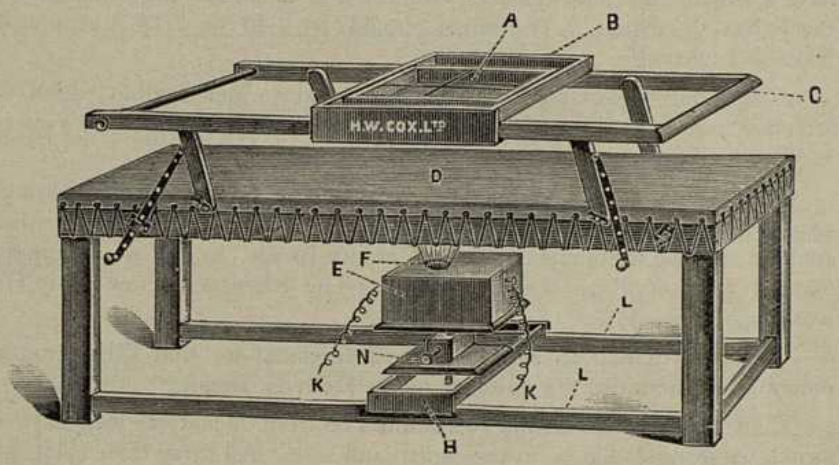
Having developed the plate or plates, set up the apparatus as shown in the drawing and allow the mirror to drop down so that a satisfactory light may be reflected up through the plates. If two plates have been exposed place them one under the other on the glass, so that the shadows on the two plates, representing the wires, coincide with the scratches across the glass. One plate which has been twice exposed is placed on the glass in the same manner. Slide the **T** piece (which carries the threads) up or down the upright to the distance that the anode was from the plate, viz., 18 in; or if two plates have been exposed, and the negatives, when placed one on the other are so dense that the image of the foreign body is not well defined, take a sheet of celluloid upon which two lines at right angles to each other have been scratched, and place the celluloid so that these lines are in register with the wire shadows on the negatives, and then trace on it the position of the foreign body on each negative. The celluloid can then be placed in the localizer in the same manner as the plates.

Place the needles points of the weights with fine threads attached on the centre of the foreign body as seen in each plate, and adjust the threads in the outer holes of the **T** piece, so that they cross each other, *i.e.*, the thread which comes from the right of the **T** piece must go to the impression on the left, and that on the left to the impression on the right. It will be seen that the holes through which these threads run are 6 centimetres apart, and that the centre hole is immediately over the marks where the wires cross on the plates. Hence the threads running from these holes to the marks on the plates representing the foreign body, represent the rays running from the anode of the tube through the foreign body on to the plate, and consequently if the patient were in a position on the localiser, the thread would pass through the centre of the foreign body. We have now found the position of the foreign body with reference to the marks of the cross wires on the plates, and the marks of these wires are also on the patient's skin.

The distance from the plate to the point of intersection of the cross threads gives the depth the foreign body was from the plate. This can be measured by means of the scribing block which is placed on the plate, and the pointer adjusted to the spot where the threads cross. On the needle being applied to the scale on the standard, the exact distance can be read. Next place the standard on one of the cross lines near the point of intersection of the threads, and with a compass take the distance from the standard to the point of intersection of the cross threads, say 3 centimetres. Next place the standard on the cross lines which is at right angles to the previous one, and take the distance to the point of intersection, say 4 centimetres. We have now found the distance the foreign body is from two fixed lines which are also marked on the patient's body, and we have also found the distance it is above or below those lines, consequently we can easily locate its exact position.

Appendix VII.

Short Instructions for using the Hall Edwards Couch.



Remove the plate carrier from the frame and lower the latter to enable the patient to be placed easily on the couch.

Raise the frame and replace the plate carrier, and then press down the frame until the plate carrier which slides along the frame is immediately over the part to be radiographed. The part of the plate carrier marked A will slide transversely, and by this means the cross wires can be brought immediately over the foreign body in the patient. The frame can now be bolted so that it cannot move, and the plate carrier fastened in position by means of the screw on one side of it. Then, by means of the sliding parts H and N, adjust the tube so that the anode comes immediately below the cross wires in plate carrier.

Having got the tube and plate in the proper position, slide the tube box 3 centimetres away from you and make an exposure.

Then slide the box 6 centimetres towards you and make another exposure on a new plate. Develop and print. The prints being placed in a Stereoscope will give a Stereoscopic view of the foreign body or injury.

Appendix VIII.

Instructions for connecting up and Working of Rheostat from Mains.

The first thing to see is that the Electric Light wires which must have a 15Amp. 2 prong wall plug connected to them, are large enough to carry heavy current. The wires should be 7/20 or 7/18 Vulcanised Electric Light wire.

The prong part of plug must be connected to the flexible which is attached to plug at side of Rheostat. Care must be taken that the switch is off while you connect plug.

This being done you may connect up the two terminals marked "Coil" on Rheostat to the terminals marked "Battery" on Coil. Also connect the two terminals marked "Mercury Break" to the two terminals marked "Battery" on Mercury Break. The Rheostat is now ready for working.

Before switching on centre switch of Rheostat see that Commutator on coil is off, and also the switches off on Mercury Break.

The sliding pieces on the Resistances on front of slate as well as the switch on studs should be to the right hand side. All three then being at their weakest point.

To start work, first switch on centre switch and then the lamp will glow. The voltmeter will record the voltage. Then switch on Mercury Break, seeing that the motor is going at a good speed. After this switch on Commutator of coil which (with discharging points 9 in. to 10 in. apart) should give a lightning stream of sparks between points.

The top sliding resistance only effects the motor on the Mackenzie-Davidson or other Motor Breaks.

The lower one increases or decreases the amount of current to the coil, and only is an intermediary resistance between either of two studs on the switch below it.

The Switch on the studs at the bottom increases or diminishes the current to the coil as will be seen on the Amp. or Volt Meters.

Be careful to switch off the current through the resistance when the coil is not working, so as to save waste and energy.

If the Rheostat is made to work in series it will be necessary to insert a lamp resistance between the Rheostat and the Motor of the Interruptor.

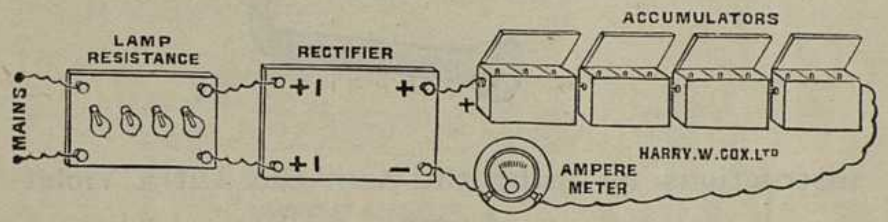
When fixing the Rheostat to a wall, we strongly recommend a sheet of $\frac{1}{4}$-in Asbestos being placed between the Rheostat and Wall.

Appendix IX.

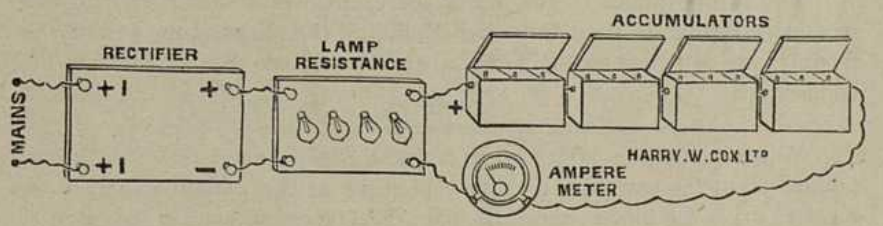
Instructions for Charging Accumulators off the Alternating Mains by means of the Chaplin Rectifier.

Divide the Salts supplied among the four Jars and fill them three parts with water.

If using the 200 volt Mains, insert a lamp Resistance sufficient to reduce the current to 4 or 6 Amperes between the Mains and the Rectifier thus:—



If using the 100 volt Mains insert the Resistance between Rectifier and Accumulators thus:—



Appendix X.

Instructions for using the Kent Cox Ultra Violet Lamp.

The two terminals on the top of the Condenser are connected to the secondary terminals of an Induction Coil, and the plugs at the end of the flexible wire attached to the lamp are inserted into the sockets in the condenser.

When using the lamp for treatment, the quartz lens should be pressed on to the part with as hard a pressure as the patient can endure, so as to drive the blood from the part. A piece of ice can be used if desired.

The lens should be frequently removed and wiped to remove the oxide which settles on it and prevents the rays from passing.

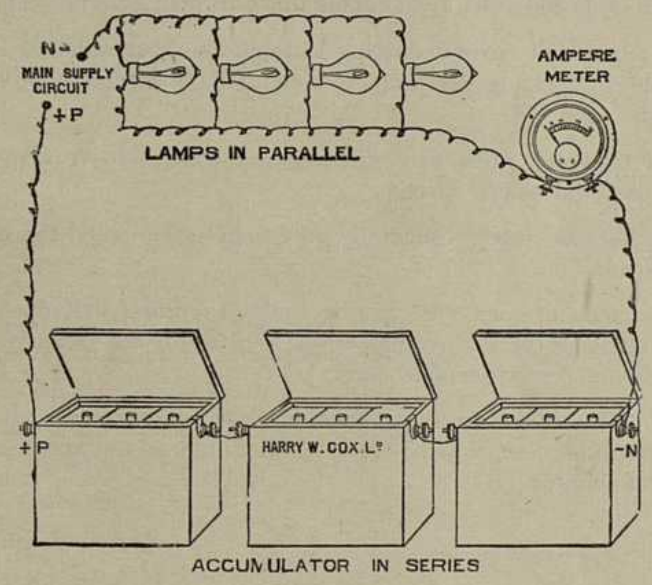
The distance between the points of the spark gap should not exceed $\frac{3}{16}$ of an inch, and not more than three amps. should be used on the Coil.

Appendix XI.

Brief Instructions for Charging Accumulators.

The density of the acid used in these accumulators is of a S.G. of 1190, which can be obtained approximately by adding one part acid to 5 parts water. When cool, this solution should be tested for Sp. G. by means of a Hydrometer, and if not of the proper density, must be brought to the right strength by the further addition of pure acid.

When the electrolyte has become cold it should be injected into the cells, and should always just cover the plates, and to counteract loss by evaporation a little pure water should occasionally be added. The accumulators should be put on charge as soon as the electrolyte is put into the cells, and the first two or three charges should be nearly double as long as the following charges in order to bring the elements into good condition, and in no case should the charging be stopped till the accumulators are properly charged.



The accumulators should be connected together in series, *i.e.*, the positive terminal of one cell is connected to the negative terminal of the next cell, and so on, leaving one positive and one negative unconnected at the ends. The positive terminal is marked thus + or painted red, and the negative terminal thus — or painted black. The two end terminals

are then connected to the mains (as described in the diagram), the positive pole of the mains going to the positive pole of the accumulators. Likewise the negative. The poles of the mains can be found by means of pole finding paper, which, when damped and applied to the wires of the mains, turns red at the negative pole.

The only thing that remains to be done now is to see that too much current is not being used. The best charging rate of a 30 ampere hour accumulator is 3 amperes for 10 hours, and a 60 ampere hour accumulator 6 amperes for 10 hours. Overcharging will do no harm providing the charging current is not excessive. Nothing tends to destroy an accumulator more than partly charging and then exhausting it. The accumulators can be charged from any direct current electric lighting circuit. If charged from the electric lighting mains of a continuous current circuit, the most convenient method is to charge through several lamps connected in parallel, using them as a Resistance. When the accumulator is fully charged, the Sp. G. of the Electrolyte should be from 1200 to 1210. Another indication of the accumulator being fully charged is that the acid becomes of a milky appearance.

Assuming that the E.M.F. of the supply circuit is 100 volts, then if the battery be placed in series with one 100 c.p. lamp this would give 3 amperes, approximately the desired current. Two 50 c.p. lamps or six 16 c.p. lamps, placed in parallel, would also give a similar current. If the supply circuit is 200 volts, then double this C.P. will give the same result.

The amount of current passing through the accumulators is easily ascertained by placing an ampere meter in the circuit (see diagram page 111).

After charging, great care should be taken to remove all moisture from the case, valves and fittings.

A pocket volt meter is generally used to ascertain when the cells are fully charged.

On no account must the cells be charged without first opening the lids and removing the rubber stoppers at the top of the cells. The lids should remain open while charging.

N.B. It is advisable when accumulators have to remain out of use for any length of time, to remove the solution, unless the accumulator is stored fully charged.

Appendix XII.

LIST OF APPARATUS as supplied in an X-Ray Outfit for one of His Majesty's Ships or for a Royal Naval Hospital.

1	10-in. Portable Coil	£30	0 0
1	Localiser fitted to it	2	10 0
1	Trolley to take Coil, etc.	12	10 0
3	6 volt. 30 ampere hour Accumulators	9	0 0
1	No. 8 Tube Holder		14 0
2	Record Tubes	1	17 0
1	12 × 9 Screen	3	0 0
1	Collapsible Fluoroscope	2	0 0
1	Plate-Changing Box	1	6 8
2	Spare Platinum Points	1	16 0
1	Wheatstone Stereoscope	2	10 0
1	Cell Tester, 8 volts	1	5 0
3	Flat Hydrometers		10 6
2	Pipettes		4 0
3	doz. Edwards' Cathodal Plates, ½	12	9
2	doz. ditto 10 × 8	14	6
1	doz. Light Tight Bags, ½	2	0
1	doz. ditto 10 × 8	3	6
4	Papier Mache Developing Dishes, 10 × 8	8	0
6	Cartons Pyro Soda Developer	6	0
28	lbs. Soda Hyposulphite, in 7-lb. bags	4	0
6	Cartons Sulpho-cyanide Toning Tabloids, A & B 6	6	0
2	10-oz. Measures	1	10
2	2-oz. Measures		10
1	Printing Frame, ½	1	2
1	ditto 10 × 8	2	0
3	Packets P.O.P. Toning Paper, ½	3	0
2	Packets ditto 10 × 8	4	0
1	Box for Sundries	10	0
1	Ruby Lamp, Electric, and 2 Spare Lamps	1	10 0

MARSHALL, BROOKES & CHALKLEY, LTD., London & Luton.