

*Recd Feb-1904*

1900

ILLUSTRATED PRICE LIST

OF

PHYSICAL AND MECHANICAL

INSTRUMENTS

MADE BY THE

SOCIÉTÉ GENEVOISE

pour la Construction D'INSTRUMENTS de Physique et de Mécanique

GENEVA, Switzerland

5 CHEMIN GOURGAS, 5



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Gold Medal at the Paris Universal Exhibition 1868  
Hors concours at the Vienna Universal Exhibition 1873  
Gold Medal at the Paris Universal Exhibition 1878  
Awards at the Swiss National Exhibition, Zurich 1883  
Hors concours, member of the Jury of the Paris Exhibition 1889  
Award at the Chicago Exhibition 1893  
Hors concours, member of the superior Jury  
of the Swiss National Exhibition, Geneva 1896  
Hors concours, member of the Jury of the Paris Exhibition 1900

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**This catalogue cancels all previous ones.**

51790

GENEVA  
PRINTED BY W. KÜNDIG & SON

## PREFACE

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We deem it useful in publishing this Catalogue to recall the circumstances in which our workshops rose from a very humble beginning.

Before 1861, there did not exist in Switzerland any factory occupied, in a general and exclusive manner, with the construction of physical and mechanical instruments. To meet this need a few friends of science, residing at Geneva conceived then the idea of creating an establishment destined to make all kinds of apparatus and instruments required for experimental researches.

At that time, under the active direction of Professor Aug. de la Rive, and aided by the experience of Professor M. Thury, the first installation was made. The thought that inspired the organizers of our workshops was the desire to afford physicists and all lovers of science, simple and reliable instruments, rigidly observing the rule never to sacrifice anything essential in order to diminish the prime cost. Experimental physicists all know, and often to their cost, how easy it is to give instruments of very different durability, the same outward appearance, and how often it happens in the end that the more expensive instrument is the one that has cost the least.

From 1861 onwards, our establishment has been constantly enlarged, and in 1870, a workshop was added for the construction of precision machines and apparatus, different from physical instruments, but intimately connected

with science, whether by the services that these apparatus can render in the laboratory, or for the reason that some instruments used in experiments become, when generalized and perfected, powerful auxiliaries for industry. Our industrial workshops by their more advantageous returns, enable us to meet the continuous sacrifices imposed on us by the study of new scientific instruments.

To dissipate errors that may be diffused among the people who are but little acquainted with our workshops, and to reply to the numerous demands addressed us almost daily for some years past, we publish to-day a catalogue of scientific instruments as complete as a first publication of this kind can be. We will observe that the greater number of the instruments enumerated have already been made by us. To comply with the desire expressed by mechanical institutions, we have added to the catalogue the prices of models for the teaching of kinematics, which our mechanical workshops enable us to execute advantageously. Thanks, also, to the help of the latter, we have been able to undertake the construction of large astronomical instruments. We have thought it well also to introduce into this catalogue two chapters devoted to Dr. Perrot's gas stoves and to hydromotors (Schmid's system) apparatus which are becoming more and more employed in physical and chemical laboratories.

The Société Genevoise undertakes the construction of any instrument of research or precision, which may be applied for, as well as the preparing of scientific or technical experiments necessitating great installations or a motive power. (*The valuable discovery of the solidification of hydrogen by M. Raoul Pictet was made in our workshops, with the help of our own apparatus.*)

In conclusion, we avail ourselves of the occasion to thank most sincerely all the persons, who have aided us by their advice.

GENEVA, May 1<sup>st</sup>, 1878.

*The Managing-Director,* TH. TURRETTINI.

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Our catalogue of 1896 being out of print, we have been induced to publish a new one, verified and augmented by a certain number of new instruments that the extension of our Works has enabled us to construct.

All our efforts will tend, as before, to afford our friends and correspondents well finished instruments, fulfilling as completely as possible all the conditions that the sciences require.

GENEVA, January 1<sup>st</sup>, 1900.

*The Managing-Director*, TH. TURRETTINI.

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## REMARKS

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The charges for packing and carriage are to be defrayed by the purchaser. The forwarding is also at his risk and peril; but, on the other hand, the Company undertakes to see that everything is carefully packed.

We beg all persons, when giving us orders, to state the means of transport they prefer, and to communicate to us whatever causes of complaint they may have, as well as the information they may desire.

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## ORDERING OF INSTRUMENTS BY WIRE

In order to avoid a useless loss of time, the Société Genevoise accepts orders by telegraph, when they come from distant countries.

In this case, the telegram must be composed in the following manner :

1. Address : **PHYSIQUE, GENEVA.**
2. The text of the dispatch will be composed of the word : **Order**, followed by the Nos. corresponding to the instruments ordered in our catalogue, edition 1900. These Nos., each composed of 4 figures, (those of previous editions are not valid) should appear in the dispatch in their order of size.
3. As verification the amount of the order should be added in francs.
4. The author of the order, must also, through the medium of his banker, open a credit account for the Société Genevoise in a Geneva bank : the amount of this credit must be at least  $\frac{2}{3}$  that of the order, and the name of the bank in which the credit account is opened must be mentioned in the telegram.
5. If several specimens of some instruments are required, several groups should be formed in the telegram, each group corresponding to the same number of specimens ; the number of specimens wanted being **written in full**

and preceding each group. The Nos. in each group should appear in their order of size.

6. Lastly the telegram must be signed and the sender should confirm the order by mail giving all necessary information.

Thus, let us suppose that Mr. A. R. Smith living at Tokio, Japan, wishes to give the following order :

Four standard metres in invar., N° 0131 at fr. 300 . . . . .	= fr. 1200
One reflection goniometer, N° 0455 . . . . .	= » 285
With adjunction of a compl. object glass, N° 0457 . . . . .	= » 20
Two mineralogist's microscopes with box, N° 2441 at fr. 530 . . . . .	= » 1060
With adjunction of an eye-piece with Nicol's prism., N° 2442 . . . . .	= » 30
Two telescope levels, 33 mm aperture, N° 1251 at fr. 250 . . . . .	= » 500
A compression pump, N° 7610 . . . . .	= » 500
	<u>Total fr. 3595</u>

the credit being opened at the bank of Messrs. Lombard, Odier & C<sup>o</sup>, Geneva, the text of the telegram will be as follows :

PHYSIQUE GENEVA

Order 0455, 0457, 2442, 7610, two 1251, 2441, four 0131, francs 3595,  
Bank Lombard. Smith.

N. B. The dispatch might be considerably simplified by the part of the order, the execution of which requires the most time, alone being given, and the rest could be indicated in the letter.

The Company declines all responsibility if the numbers should not be transmitted correctly by the telegraph-office; besides the execution of the order will be put off if the amount of the latter does not correspond exactly with the number of francs stated in the telegram.



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# CHAPTER 0

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## GENERAL MEASURING INSTRUMENTS

- § 00. Dividing Machines.
- 01. Standard Meters, Scales, etc.
- 02. Comparators, Cathetometers, Micrometers.
- 03. Measuring Machines, Callipers, etc.
- 04. Measurement of Angles, Areas and Volumes.
- 05. Dynamometers.
- 06. Analytical Balances. Standard Weights.
- 07. Manometers.
- 08. Pendulums.
- 09. Metronomes, Tuning Forks, Chronographs, Chronometers.

*The units of measure adopted are those of the system C. G. S. (centimetre, gram, second) to which may be added :*

*the degree or 300<sup>th</sup> part of the circumference,*  
*the grade or 400<sup>th</sup> " " " "*  
*the micron or 10 000<sup>th</sup> " " " centimetre.*

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### § 00. Dividing Machines.

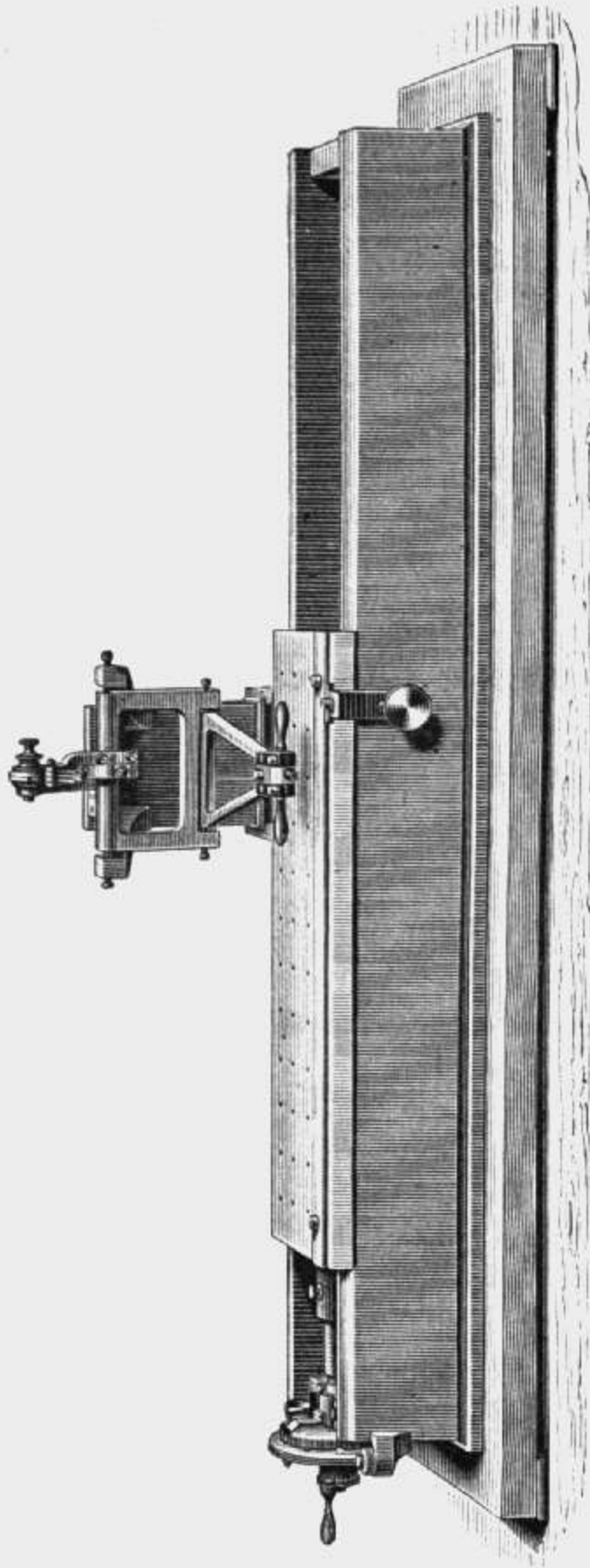
**Dividing machine for straight lines.** — The « Société Genevoise » possesses in its work-shops a machine for dividing straight lines to the construction of which all the improvements suggested by modern technology have been applied. The reputation of this machine, which may be considered as one of the most complete at present existing, has brought the Société Genevoise orders for metrical standards from many Governments in different parts of the world.

The machine is driven automatically, that is, all the work of dividing is done mechanically. Thus we avoid not only the

Nos

Francs.

errors due to the temperature of the body of the operator, but also those resulting from his inattention or fatigue. The machinery offers the advantage of being more regular, since its action is always constant. A special contrivance permits the cor-



0001.

Nos

Francs.

rection of errors due to changes of temperature and thus a division can be made at one temperature, which will be correct at another given temperature. By the same means, any kind of division of length can be made, even when the ratio of the pitch of the main-screw to the length of the division requireds should be irrational.

The error curve of the screw has been conscientiously studied and corrected, so that the exactness of the hundredth of a millimetre can be warranted.

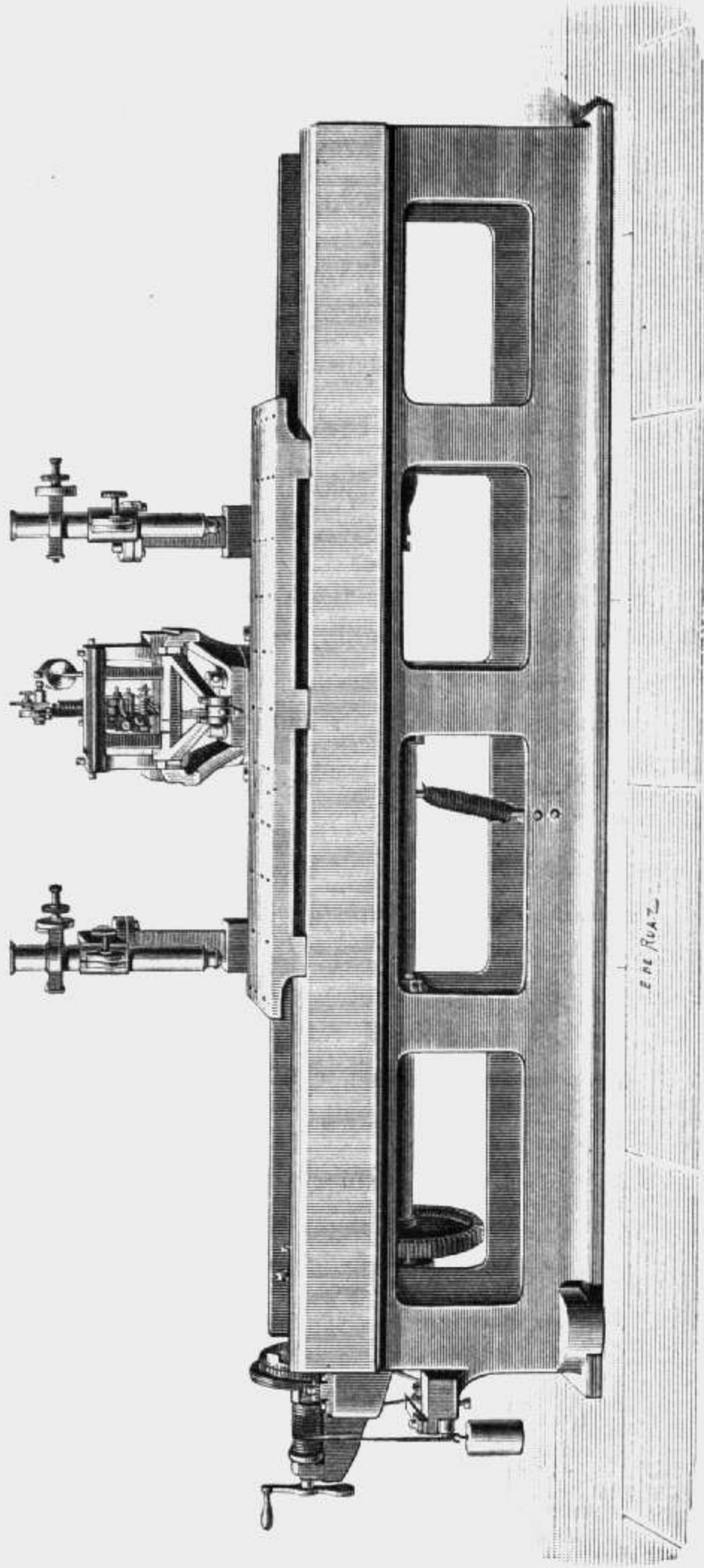
**Dividing machine for circles.** The machine for dividing straight lines has also served to trace subdivisions of a machine for dividing circles, placed beside it on the same bed of beton. The maximum of error in the division of the normal circle of one metre in diameter is less than one second. It would be impossible to demand more, when we consider that the arc of one second at the circumference of the graduated circle represents about  $\frac{1}{400}$  of a millimetre.

0001. **Dividing machine for straight lines.** Laboratory model. The screw has a millimetre thread and divisions as fine as 0.005 mm. can be made directly by a ratchet wheel. The tracelet is stationary and arranged so that lines of different lengths are made mechanically ; it permits the tracing of transversals ; the object to be divided moves automatically as the screw is turned and without reading. A scale 350 mm. long can be graduated without interruption. The total length of the machine is 85 centim. (*fig.*) . . . . . 650

This machine can be provided with one or two micrometer microscopes. The latter instruments very usefully complete this model and facilitate the prolonging of a graduation.

0002. Price of a **microscope** with support adapted to the machine . . . . . 150

0005. **Dividing machine for straight lines.** Same model as the preceding one. The tracelet is easily removed and replaced by two micrometer microscopes sliding over the whole length of the machine. This contrivance enables one to employ the machine as comparator . . . . . 950



0025.

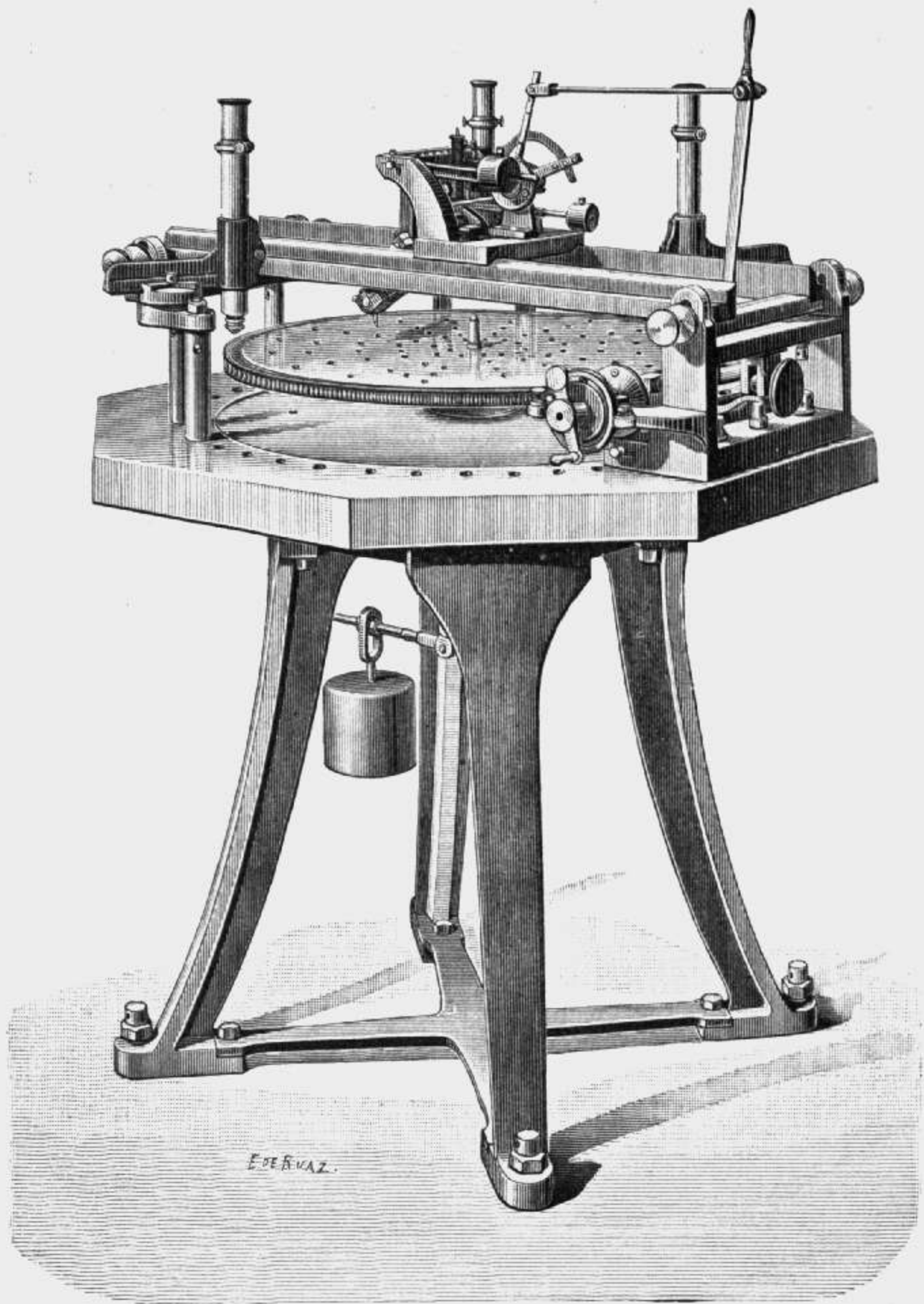
Nos		Francs.
0010.	<b>Dividing machine for straight lines</b> combining all the advantages of the preceding ones and capable of dividing a length of 55 cent. ; the length of the machine is 130 cent.	1100
0015.	<b>Do.</b> same model with a more perfect tracelet . . . . .	1250
0020.	<b>Dividing machine.</b> Model n° 0001, much simplified ; the automatic part of the machine is replaced by a drum divided into 100 parts permitting graduation in divisions of any length . . . . .	500
0025.	<b>Dividing machine</b> for lengths up to 50 centimetres. Stronger construction, more perfected tracelet. Contrivances for applying a correction curve to the screw and executing an exact division at any given temperature ; length of the bench 140 centim., microscopes and accessories ( <i>fig.</i> ) . . . . .	2800
0030.	<b>Do.</b> The same machine designed to make divisions automatically by transmission of a continuous circular motion . . . . .	3000
0035.	<b>Adjunction</b> to the two preceding models of a platform with a tangent screw, for making circular divisions up to 17 centim. in diameter and also gratings either circular or with crossing straight lines . . . . .	200
0040.	<b>Dividing machine</b> for graduating lengths up to 50 centim. Machine of great precision acting automatically, with carefully corrected screw, giving an approximation of $\frac{1}{100}$ millim. in all its length and allowing the execution of any kind of division at a given temperature. The thread of the screw is millimetric . . . . .	4500
0045.	<b>Do.</b> for graduating lengths up to one metre, similar to n° 0040 with two microscopes . . . . .	5500
0050.	<b>Dividing machine</b> for graduating the length of one metre without interruption. The pitch of the screw is 1 or 2 millim., the diam. 35 millim. The approximative exactness $\frac{1}{100}$ millim. The total length of the machine is 220 centim. it is provided with a micrometer microscope sliding over the whole length of the machine . . . . .	2500
0055.	<b>Small dividing machine,</b> for executing automatically micrometric divisions on glass or metal. The greatest length	

Nos

Francs.

that can be divided is 35 millim. the greatest length of stroke obtainable is 5 millim. . . . .

800

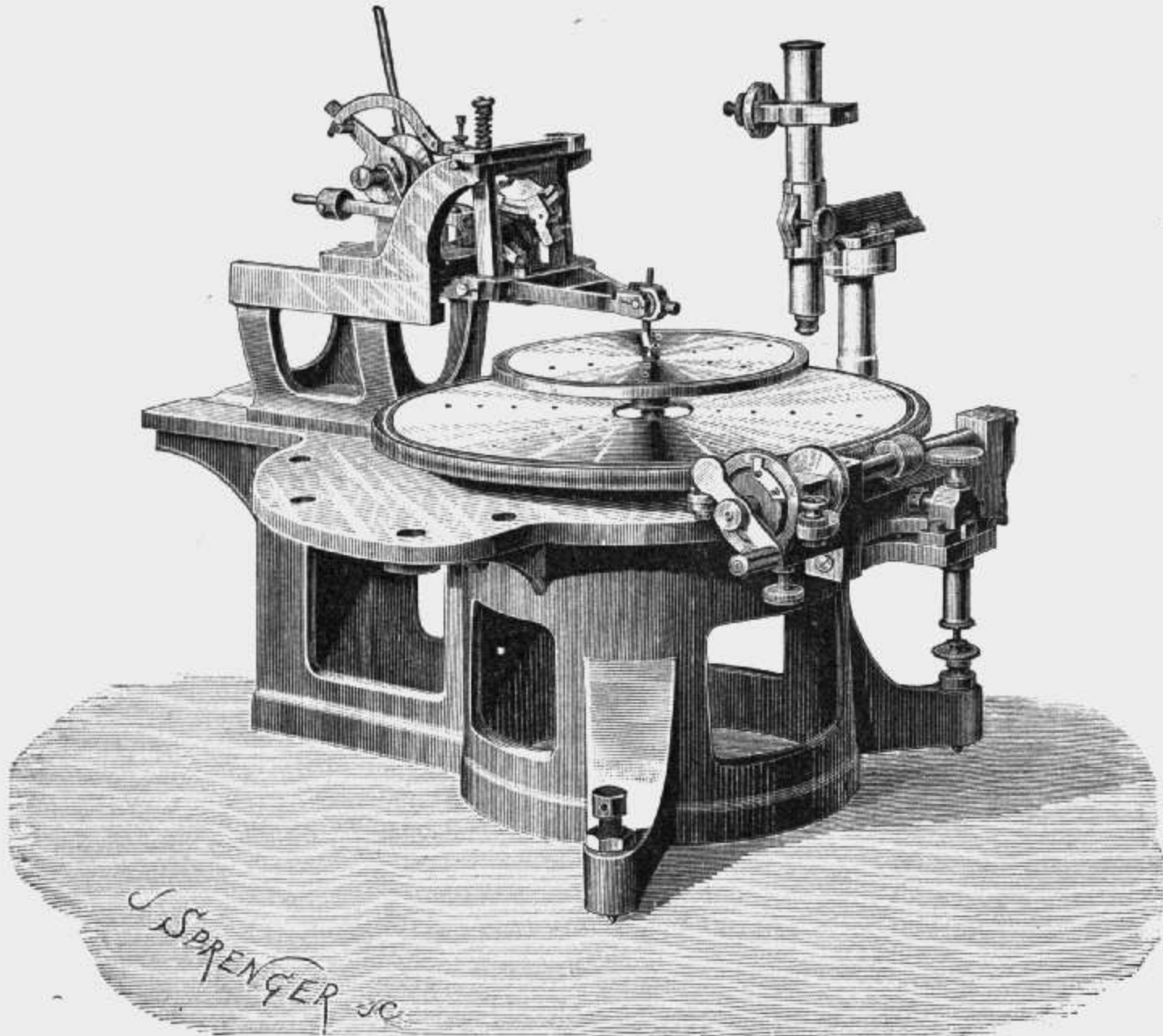


0060.

Nos

Francs.

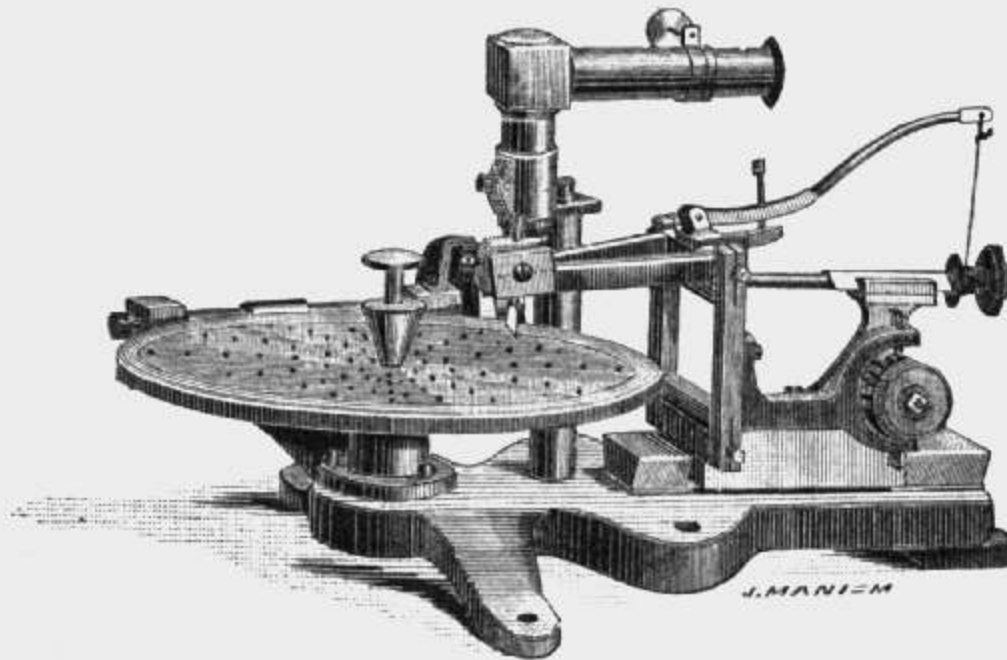
0060. **Dividing machine for circles** up to 50 centim. in diameter. The circle is graduated in twelfths of degrees. Three microscopes, one of which with micrometer, help to read or verify the division. A tangent screw with a pitch corresponding to  $\frac{1}{3}$  degree serves to adjust the division under the microscope or to make divisions rapidly with an approximation of about 20 seconds; it is provided with a certain number of ratchet wheels for making divisions other than those of the circle. The machine is mounted on a cast-iron frame-work with 4 legs connected together, and is surmounted by a glass case (*fig.*) . . . . . 4800



0070.

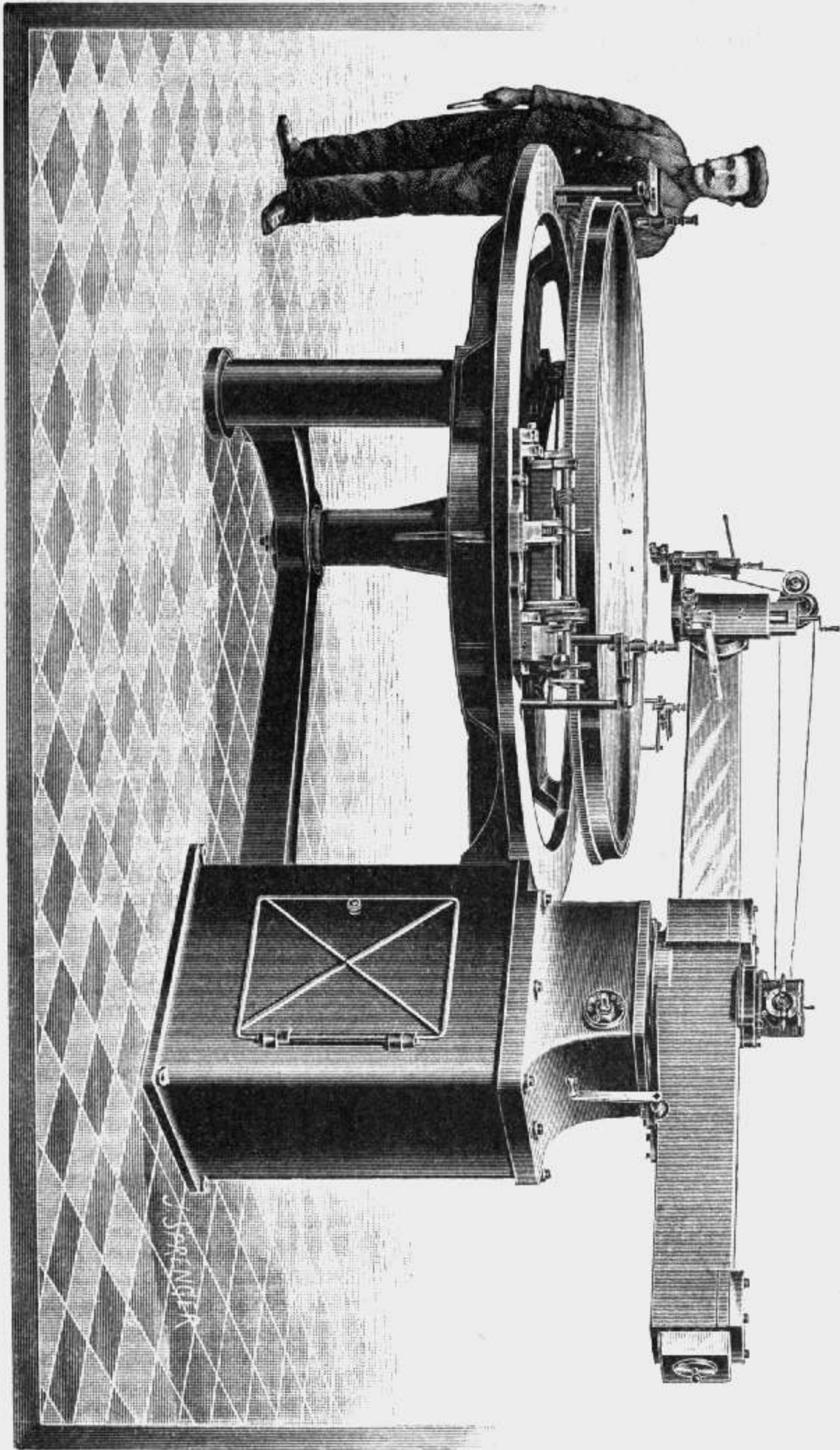


Nos		Francs.
0065.	<b>Circular platform</b> , 31 centim. in diameter . . . . .	650
	<i>These platforms may be provided, to order, with any number of divisions.</i>	
0070.	<b>Dividing machine for circles.</b> Similar to n° 0060, platform 35 centimetres in diameter. Two microscopes, one provided with an ocular micrometer. The machine is constructed without a foot, so as to rest on a table ( <i>fig.</i> ) . . . . .	2000
0075.	<b>Do.</b> with divisions on silver to sixths of degrees and divisions for verniers. The machine is provided with a microscope for exact adjustment of divisions. The platform 25 centim. in diameter has a tangent screw with divided head. This screw serves, either for rapid execution of regular divisions or to make irregular divisions ( <i>fig.</i> ) . . . . .	700



0075.

0080.	<b>Do.</b> with adjunction of special ratchet wheels to advance the plate mechanically for a great number of divisions . . . . .	850
0085.	<b>Circular platform</b> for rapidly drawing the divisions of the circle when very great precision is not necessary. Brass plate 25 centim. in diameter with alidade and point for fixing the plate in each position. Divisions marked by 360 and 400 dots, with dots for verniers used ordinarily with these numbers. . . . .	450



0090.

Nos

Francs.

0090. **Industrial dividing Machine** capable of dividing circles up to two metres in diameter. The tracelet is borne by a movable arm allowing it to be shifted over the whole surface of the plate and to trace divisions not passing through the center of the circle but enveloping a concentric circle.

The tracing-point is so adapted to the tracelet as to be able to make conic divisions, i. e.: divisions, inclined with respect to the horizontal platform. The machine can work in both directions. To make thick strokes, the tracing point can be replaced by cutting tools of different widths; the cutting machine is driven by an electro-motor fixed on the movable arm (*fig.*) 15000 and upwards.

**Machine for dividing into unequal parts.** The « Société Genevoise » undertakes to construct these machines in all sizes and reserves the right of treating for the construction and price, as the latter varies according to the exactness required, the use to be made of the machine and the lengths or diameters to be divided.

### § 01. Standard Metres, Scales etc.

The « Société Genevoise » undertakes, on demand, to get the « Bureau international des Poids et Mesures » to verify the standard metres made in its shops; but it reminds its customers that these comparisons are subject to special regulations established by the International Bureau, from which we extract the following:

« ART. 2. — The tests to be executed at the International « Bureau must be strictly limited to standards of the highest order. « Orders which do not come from Governments may be addressed « to the Director of the International Bureau at the pavillon of Bre- « teuil, Sèvres (*near Paris*). But they are, in all cases, submitted « to the Board, who decide whether they can be received and give « the necessary authorization. »

« ART. 7. — *Measures of length.* — To be accepted, standards « of length must belong to the metrical system; their length may be « 1, 2, 3 or 4 metres. They may be end metres or line metres, « of metal or hard stone. For end standards the terminal surfaces

Nos

Francs.

« must be sufficiently perfect and intact to clearly define the length.  
 « For line standards the divisions must be traced on the plane  
 « of the neutral fibres, they must be distinct and fine enough to  
 « be well observable when magnified about 60 times. »

« Some of the preceding rules may, exceptionally, be left in abey-  
 « ance, for instance the condition of the plane of the neutral fibres,  
 « for articles presenting an important historical value, geodetic rules,  
 « the fundamental standards of the geodetic surveys, small scales  
 « constituting decimal subdivisions of the metre, (decimetre, centi-  
 « metre, millimetre) and micrometric divisions on glass or rock  
 « crystal. »

« For measures of length the owners may claim :

- « a) a test in the local temperature ;
- « b) the complete equation with determination of the dilatation ;
- « c) for graduated scales, the testing of the subdivisions. »

« ART. 11. — The tests desired by the governments of States, which  
 « have adhered to the Convention of the Metre, are made without  
 « charge. »

« Public or private institutions, as well as scientific men or con-  
 « structors from States, which participate in the Convention, shall  
 « pay the following fees, as fixed by the Board, in virtue of article 15  
 « of the Regulations annexed to the Convention. »

I. — MEASURES OF LENGTH.

« Metrical measures with subdivisions.

1. A test in the local temperature . . . . .	60
2. Determination of the dilatation either by the method of the com- parator or by Fizeau's method, when a sample prepared for this purpose has been furnished by the owner . . . . .	150
3. Gauging the subdivision of a metre rule, i. e: testing each centimetre and the millimetres of one centimetre (110 strokes) .	400

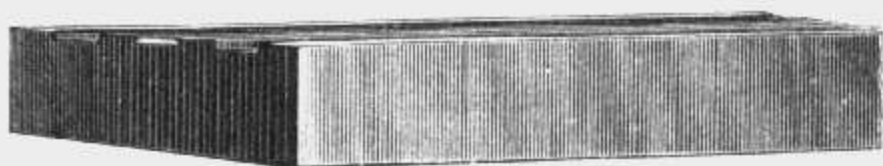
« For standards belonging to other systems than the metric  
 « system, for end measures and in general for the exceptional cases  
 « stated in the above circular, the fees shall be fixed by the Direc-  
 « tor of the Bureau, in agreement with the Board, taking into ac-  
 « count the work necessitated by each demand. »

« The governments of States which have not adhered to the Con-  
 « vention, as well as their subjects or citizens, shall have to pay the  
 « double of these fees, and the Bureau shall take no responsibility  
 « in case of delays in the execution of the tests. »

« ART. 12. — The owners have besides to pay the cost of car-  
 « riage, packing and any other expenses resulting from the sending  
 « of the objects by mail or railway. »

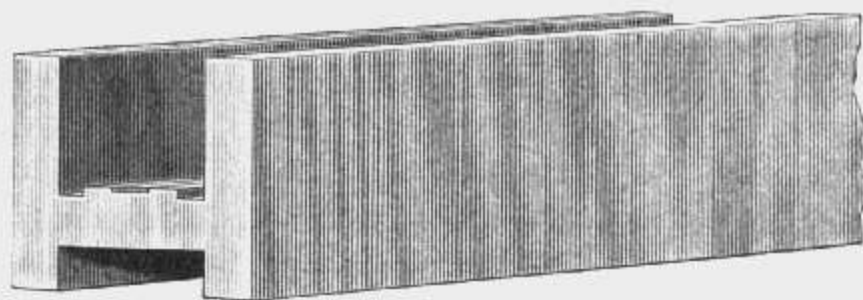
« The fees are payable on the delivery of the certificates, or on  
 « receiving them by mail against payment. »

Nos	Francs
<p>By virtue of this regulation, the standard metres nos 0130, 0131 and 0135 are the sole metre scales constructed by the « Société Genevoise », which may be submitted to the verification of the International Bureau.</p>	
0100. <b>Standard Metre Scale</b> , of brass. — Very hard brass bar, 10 millim. thick and 20 millim. wide, divided into centimetres, the first decimetre into millimetres; in case . . . .	70
0105. <b>Standard Metre Scale</b> , of brass, divided into millimetres on silver; principally used as scale of comparison in scientific researches with the help of a telescope or reading microscope ( <i>fig.</i> ) . . . . .	130



0105.

0110. <b>Standard Metre Scale of H-form</b> , divided in millim. on silver, the first and last millim. subdivided in tenths. ( <i>fig.</i> ) The form of this metre was suggested by the « Bureau international des Poids et Mesures » and adopted because the divisions are on a surface in the neutral axis of the system and will not be affected by flexion. It also offers maximum resistance for minimum mass and maximum surface . . . . .	180
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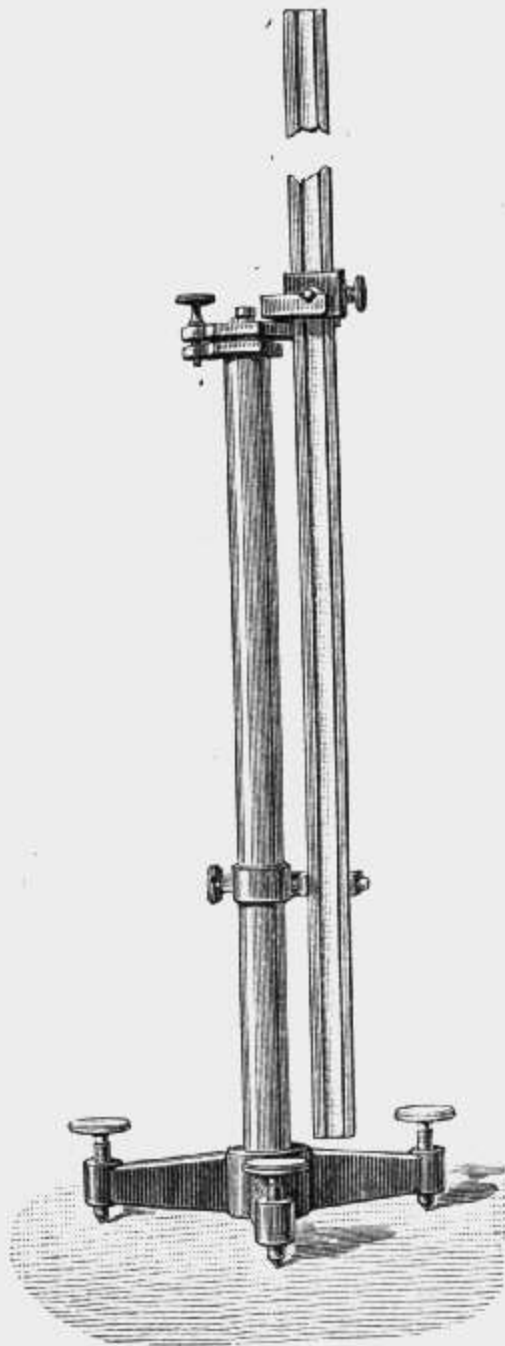
0110.

0115. <b>Stand</b> with all the adjustments necessary for suspending and adjusting the metre n° 0105 and following ones ( <i>fig.</i> ) . . . .	120
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Nos

Francs.

0120. **Standard Metre Scale of H-form**, larger size, phosphorous bronze divided on silver like the preceding one. Brass, according to the quantity of zinc it contains, undergoes in time molecular changes; phosphorous bronze is less liable to these changes, and the result is a greater fixity of the length of the metre . . . . . 300



0115.

0125. **Steel Standard Metre** divided on platinum. Dimensions those of fig. 0105. This model is constructed for laboratory work in which sulphurous vapours would rapidly deteriorate divisions on silver. The employing of steel is required by the dilatation coefficient of platinum. The price of the metre is

Nos	Francs.
<p>120 francs, plus the platinum, the price of which varies ; about 60 grams are required for the making of the metre.</p>	
<p><b>Standard Metres of Nickel-Steel called « Invar ».</b></p>	
<p>Alloy of steel containing 36<sup>o</sup>/<sub>100</sub> of nickel, recently introduced into Metrology by the « Société de Commentry-Fourchambault et Decazeville, » as the result of experiments made at the Sevres International Bureau of Weights and Measures, by M. Ch.-Ed. Guillaume. The principal advantage of this alloy is its very slight dilatibility, confined, according to specimens, between one fifth and one tenth of that of platinum. Under certain particular forms this dilatation may be still considerably reduced. This alloy takes a fine polish, is perfectly in-oxidable in dry or moist air, but can get rusty by staying a long time in hot water ; it is rather easily corroded by acids, which necessitates some precautions in using it.</p>	
<p>The nickel-steel metres are divided into millim. and made on the model of nos 0105 and 0110.</p>	
0130.	220
<p><b>Invar Metre Scale</b> constructed on the model of n° 0105</p>	
0131.	300
<p><b>Do.</b> constructed on the model of n° 0110 . . .</p>	
0135.	300
<p><b>White Bronze Metre Scale</b> (60<sup>o</sup>/<sub>100</sub> copper, 40<sup>o</sup>/<sub>100</sub> nickel) <b>or pure nickel</b> ; cross section of H-form, large size, with divisions on the plane of the neutral fibres. The metal, specularly polished, is susceptible of receiving lines of extreme fineness.</p>	
<p>Price according to dimensions, 22 to 27 millim. . . . . and upwards.</p>	
0136.	220
<p><b>Do.</b> constructed on the model of n° 0105 . . .</p>	
<p>White bronze and nickel are distinguished from bronzes hitherto employed for the same purpose, by a much greater rigidity and less dilatation. Their permanency towards ordinary chemical agents, to which they may be accidentally exposed in laboratories, permits of doing away with the incrustation of another metal in the plane of the tracing.</p>	
0140.	140
<p><b>Double-Metre Scale of Steel.</b> End metre. Bar 25 millim. square or rectangular 35 × 12 millim., divided into millim. down its whole length . . . . .</p>	

Nos

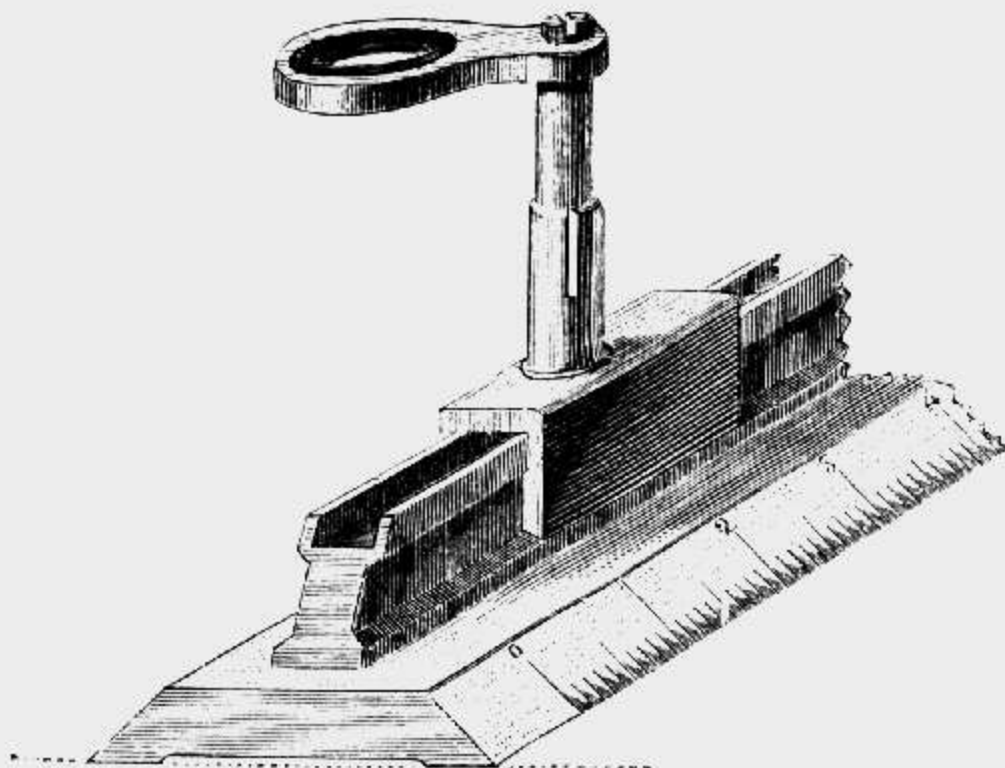
Francs.

0145. **Brass Standard Metre with projecting extremities.** — Model adopted by the Swiss Confederation. Brass bar 10 millim. thick and 25 millim. wide, divided into millim. A so called « heel » or « nib » at each end, with intervening distance exactly one metre for testing end metres. With case (*fig.*) . . . . . 90



0150. **Steel Metre with projecting extremities.** Model adopted by the Swiss Confederation as the metre of control for trade and commerce (*fig.*) . . . . . 35

0160. **Rule with German Silver Beveling,** divided on one side into millim., on the other into fifths of millim down its whole length. Each stroke of the millim. subdivision is of a different length. Magnifying glass for reading the scale; 70 centim. long (*fig.*). With case . . . . . 140



0160.

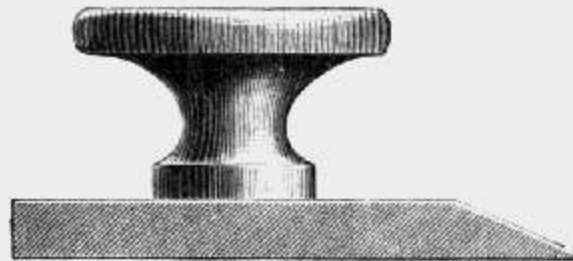
0161. **Rule with German Silver Beveling,** 105 centim. long 170



Nos		Francs.
0165.	<b>Rule or Scale of Steel</b> , divided into millim. or according to any other measure ; flat or with bevel ; 1 metre long . . .	60
0166.	<b>Do.</b> 50 centim. long . . . . .	35
0170.	<b>Brass Scale, with bevel on one side</b> , divided into millim. ( <i>fig.</i> ) 125 centim. long. . . . .	45
0171.	<b>Do.</b> 1 metre long . . . . .	40
0172.	<b>Do.</b> 50 centim. long . . . . .	25
0173.	<b>Do.</b> 40 centim. long . . . . .	15
0174.	<b>Do.</b> 30 centim. long . . . . .	9

*These rules are without cases.*

0175.	<b>Brass Scale, with two bevels</b> , graduated on one side for millim., on the other for half millim. ( <i>fig.</i> )		
		Brass	German silver
	50 centim. long . . . . .	32	40
0176.	<b>Do.</b> 40 centim. long . . . . .	20	25
0177.	<b>Do.</b> 30 centim. long . . . . .	14	18
0178.	<b>Do.</b> 20 centim. long . . . . .		9



0170.



0175.

0180.	<b>Steel Metre for Modeller</b> with metrical divisions allowing for the shrinkage of iron and brass . . . . .	50
0185.	<b>Small Scale in German Silver</b> , 11 centim. long, divided on one side on the bevelling into fifths of a millim., on the other into millim. ; with case . . . . .	16
0186.	<b>Do.</b> Graduated on one side for fifths of a millim. on the other for tenths of a millim. . . . .	20
0190.	<b>Two Brass Scales</b> , each with two bevels. On one of the scales, the distances 199.9 and 200.1 millim., on the other,	

Nos	Francs.
the distances 199.8 and 200.2 millim., are subdivided into 200 parts, to allow for the average hygrometric state of surveyor's plans . . . . .	35

It is impossible to mention all kinds of subdivisions and of non metrical measures nor all the variations of form and size that may be desired. This paragraph only contains the scales which seem to us most in request, and is merely intended to give a general idea of the prices. Any other scale can be made to order, and at a price differing but little from those stated above.

The arrangement of our dividing machine permits us to divide rules up to 4 metres long.

All our standard metres are compared with our normal metre as verified by the Paris International Bureau of Weights and Measures. We can therefore guarantee our customers the total error of every metre rule delivered, at the temperature at which it was divided, an error which will not exceed  $\frac{1}{100}$  millim. for line metres and  $\frac{1}{30}$  millim. for end metres. Save special demand, our metres are divided at an approximate temperature of 15° Cent.

0195. **Scale with Transverse Lines**, 25 centim. long; the division is continued on the bevels for direct measures :

	Brass	German silver
with two divisions . . . . .	12	14
0196. <b>Do.</b> with four divisions . . . . .	15	17.50

**§ 02. Comparators, Cathetometers, Micrometers.**

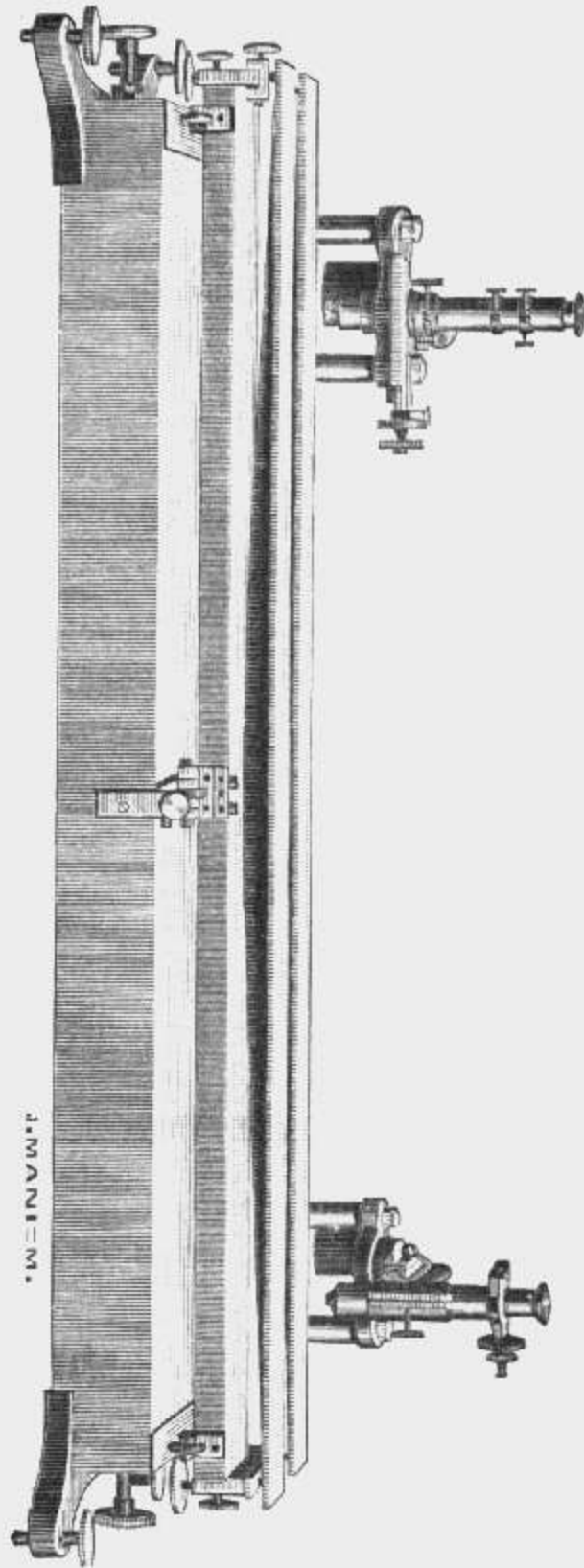
0200. **Comparator for End Measures.** Contrivance for comparing all lengths up to one metre. The differences of length are shown by a touch lever, whose vernier indicates  $\frac{1}{1000}$  millim. 550

0205. **Comparator for Line Measures.** Iron bench with levelling screws, on which two microscopes capable of a

Nos

Frans.

transversal movement can slide longitudinally. One of these microscopes is mounted on a Fraunhofer's micrometer, the other is provided with an ocular micrometer and its movable thread.

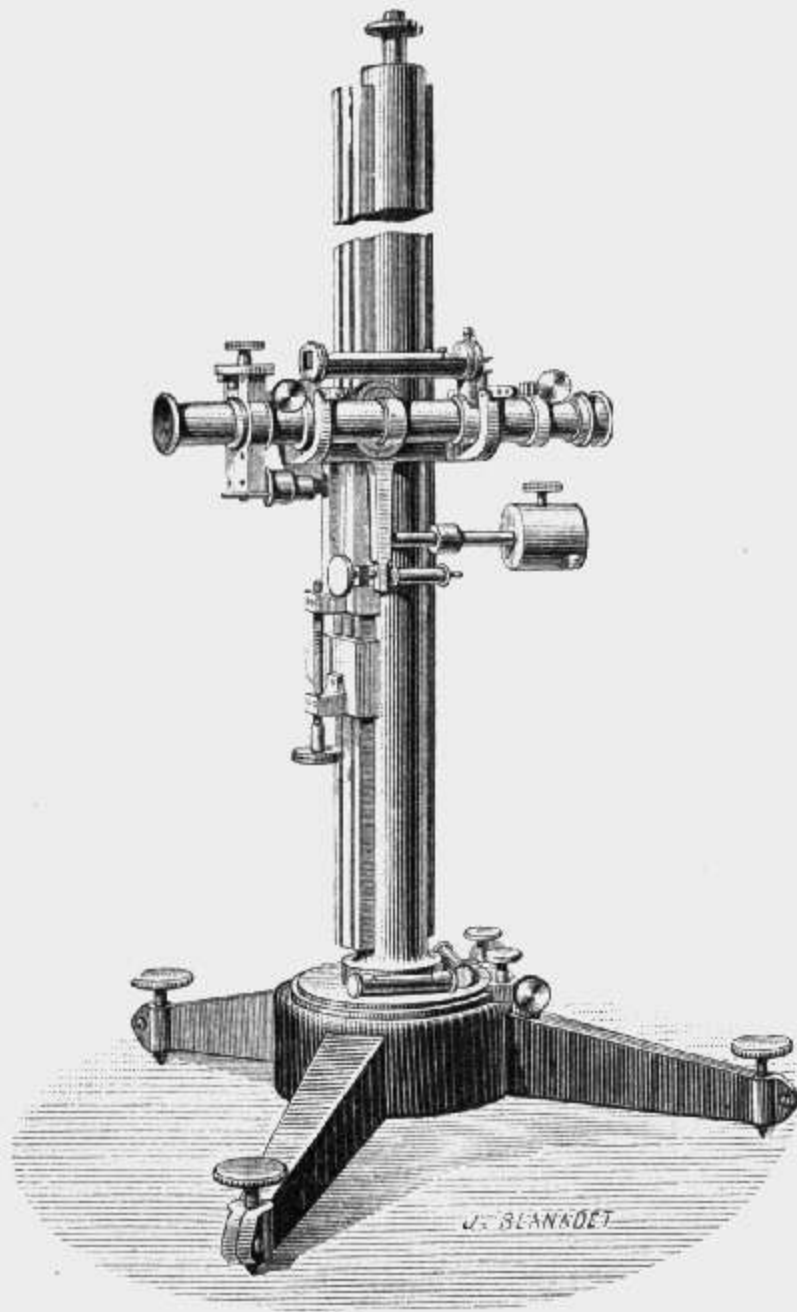


0205.

The bench is surmounted by an iron shelf that shifts rapidly transversally. On the shelf two rules with adjusting screws

Nos	Francs.
for the vertical and longitudinal directions, are suitably fixed and designed to receive the measures to be compared. The latter may be as much as one metre long ( <i>fig.</i> ) . . . . .	1000
0210. <b>Comparator for Line Measures.</b> Model similar to the preceding but of simpler construction . . . . .	750

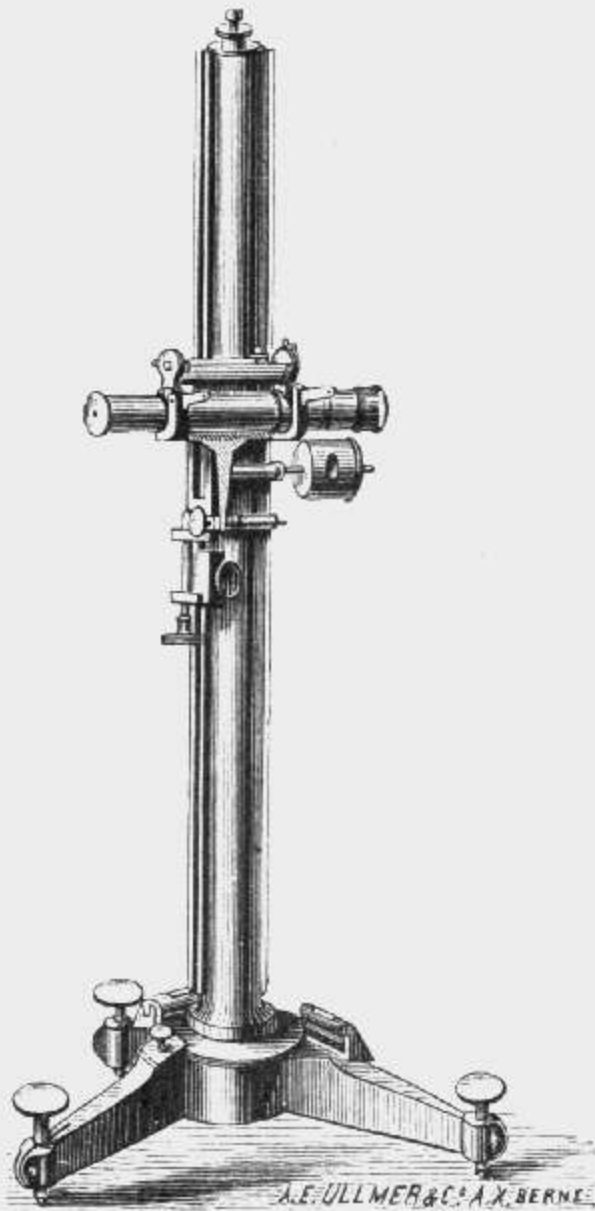
**Comparators,** see also *Heat* § 41.



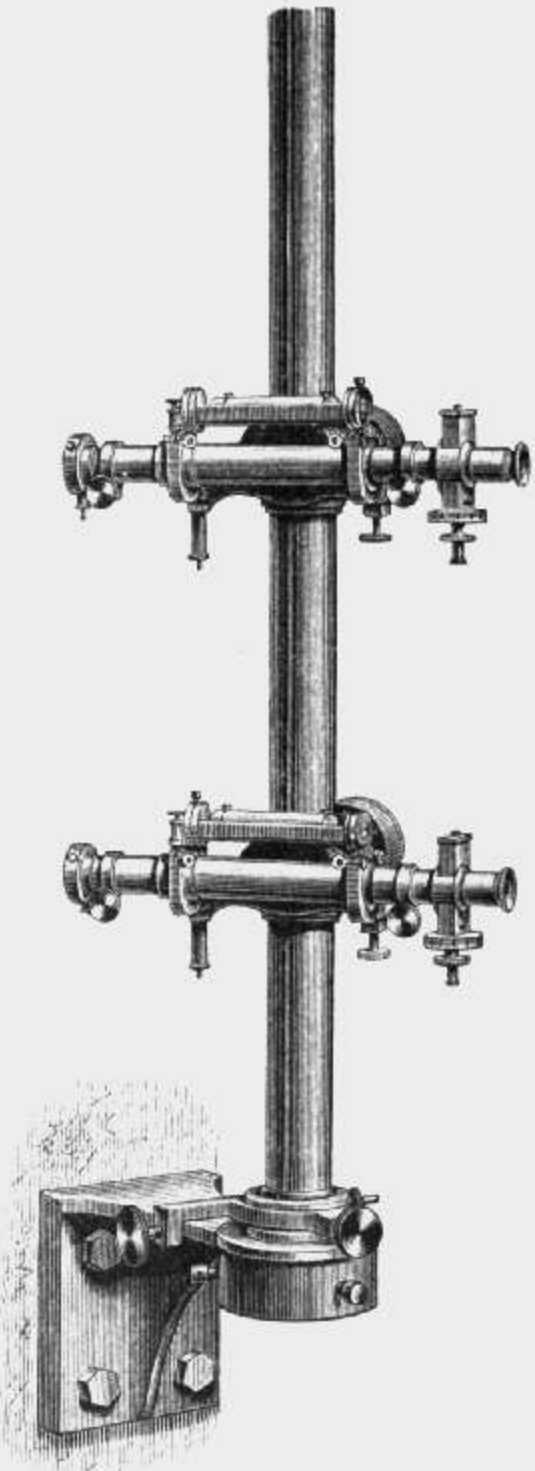
0220.

0215. <b>Large Cathetometer</b> for measuring one metre in height; millim. divisions on silver; vernier reading to $\frac{1}{50}$ millim.; well balanced prismatic cursor. The column is pivoted above on a central axis. Telescope and level may be turned end to end; two levels at right angles to each other on the base. . . . .	900
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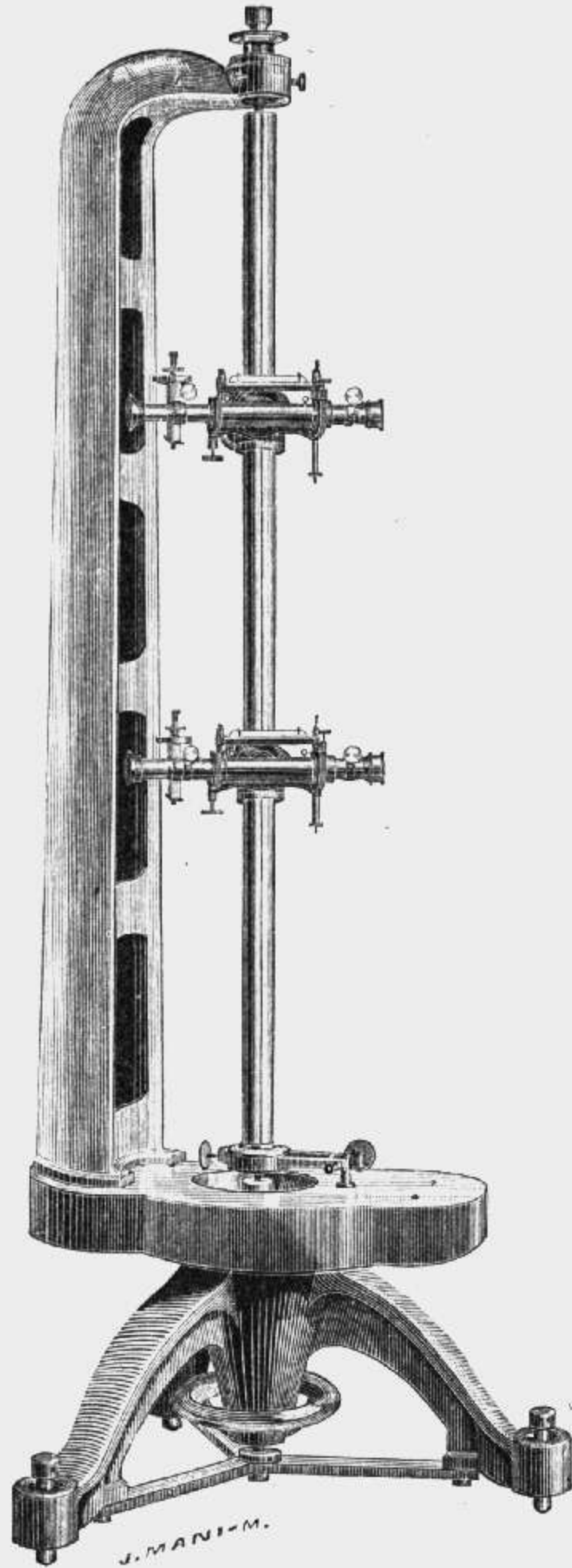
Nos	Francs.
0220. <b>Large Cathetometer</b> with adjunction of a second object glass for very short distances and provided with a micrometric screw whose head bears divisions on silver ( <i>fig.</i> ) . . . . .	1000
0225. <b>Cathetometer</b> , same model as preceding ones, <i>but with two telescopes</i> . This arrangement including two micrometers guarantees greater accuracy and permits measurement of a maximum distance of 116 centim. . . . .	1400
0230. <b>Cathetometer</b> , smaller size, to measure a height of 50 centimetres; same construction as above, vernier reading to $\frac{1}{50}$ millimetre ( <i>fig.</i> ). . . . .	600



0230.

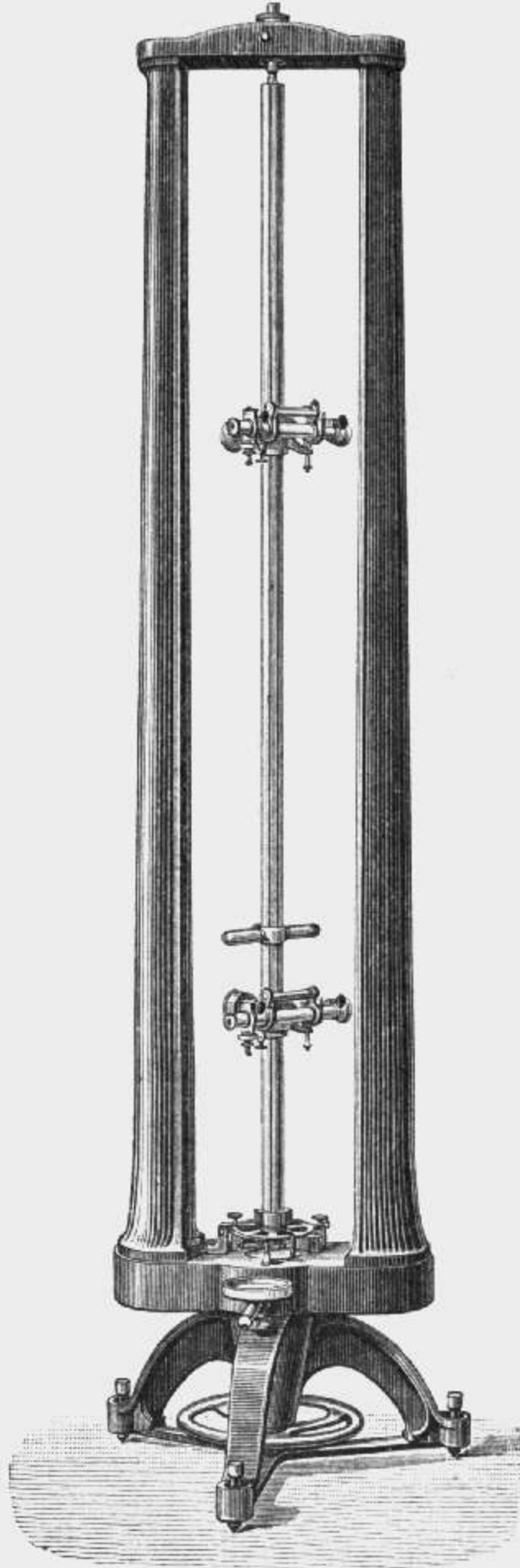


0245.



0250.

Nos	Francs.
0235. <b>Cathetometer</b> , with the addition of an extra object-glass and a screw micrometer with adjustable thread. . . . .	700



0255.

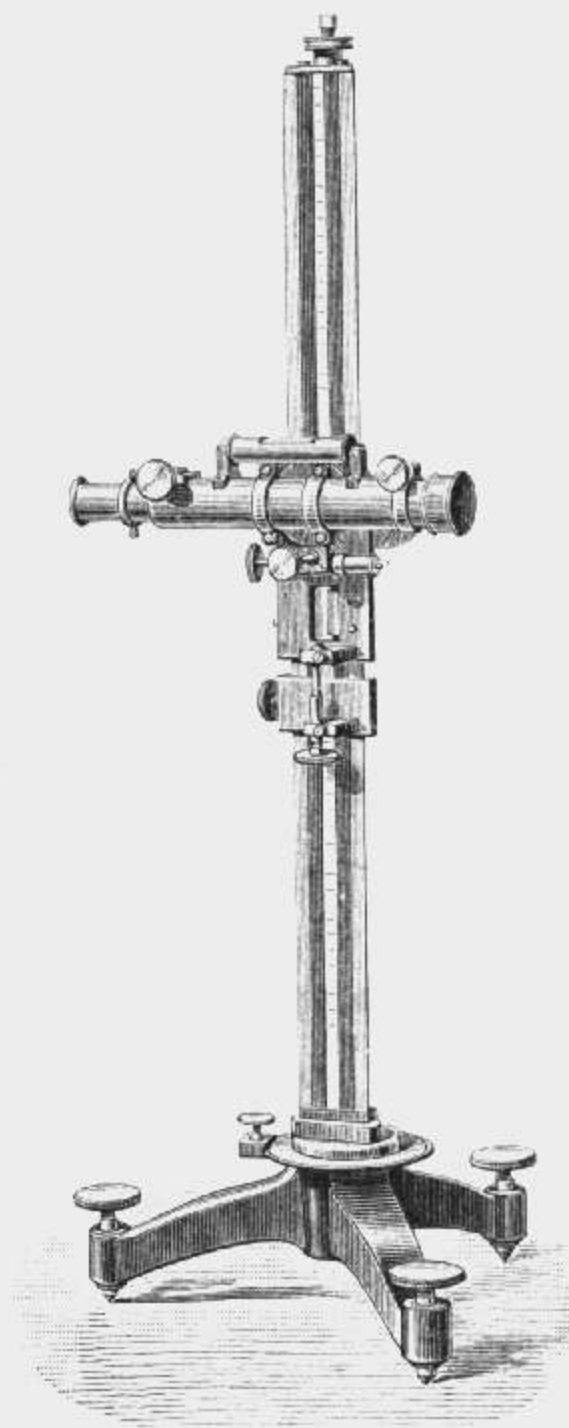
Nos	Francs.
0240. <b>Cathetometer</b> for measuring 70 centim. in height . . . .	740
<i>These models of cathetometers can be supplied with a rack and pinion the whole length of the column; the cursors glide then more smoothly and the steadiness of the instrument is better secured.</i>	
0245. <b>Cathetometer with two Telescopes</b> , each provided with a micrometer. These telescopes can be shifted longitudinally on a steel or brass column, pivoting on its axis and suspended to a strong cast iron support, which may be fixed against a pillar or wall ( <i>fig.</i> ); a second support, in the lower part, secures the verticality of the column. The maximum distance between the telescopes permits the measuring of a little more than one metre. The column is not graduated: measurements are taken on a standard metre placed beside the object to be measured. The extremities of the latter are noted and by turning the whole column with its telescopes, the observer reads the standard metre (n <sup>o</sup> 0105 or 0110). The same instrument may be furnished with a column two metres high.	900
0250. <b>Cathetometer with two Telescopes.</b> The preceding instrument mounted on a very firm cast iron support, pivoted above on a strong tripod with levelling screws. This arrangement presents the great advantage of rendering the instrument transportable and easily adjustable in any position ( <i>fig.</i> ).	1350
0251. <b>Adjunction</b> , to the lower part of the column, of an azimuthal circle with verniers . . . . .	70
0255. <b>Cathetometer</b> like the preceding, mounted as in the figure, to measure the height of two metres. The total weight of the instrument is about 230 kilogr.. . . . .	1850
0260. <b>Cathetometer</b> with telescope 27 millim. aperture without reversing movement, although it can be turned on a horizontal axis provided with an adjusting screw so as to place the telescope at an angle with the column. Triangular brass column 65 centim. high pivoted above on an internal axis. The brass column bears a millimetric division with vernier reading to $\frac{1}{20}$ millim. Spirit level to secure the horizontality of the telescope ( <i>fig.</i> ) . . . . .	425



Nos

Francs.

0265. **Cathetometer of Simple Construction.** The triangular column 115 centim. high is divided into millim. ; vernier reads to  $\frac{1}{20}$  millim. This column turns on its axis of figure. The telescope 27 millim. aperture permits reading distances varying between 0.60 and 10 metres ; it may be inclined at any angle ; spirit level on the telescope. . . . 400



0260.

0270. **Do.** same instrument as the preceding, but the telescope can only be used in a position nearly horizontal . . . 300

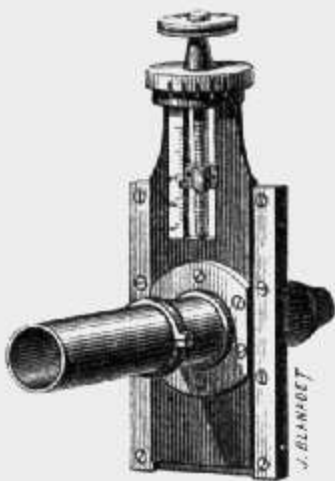
Nos

Francs.

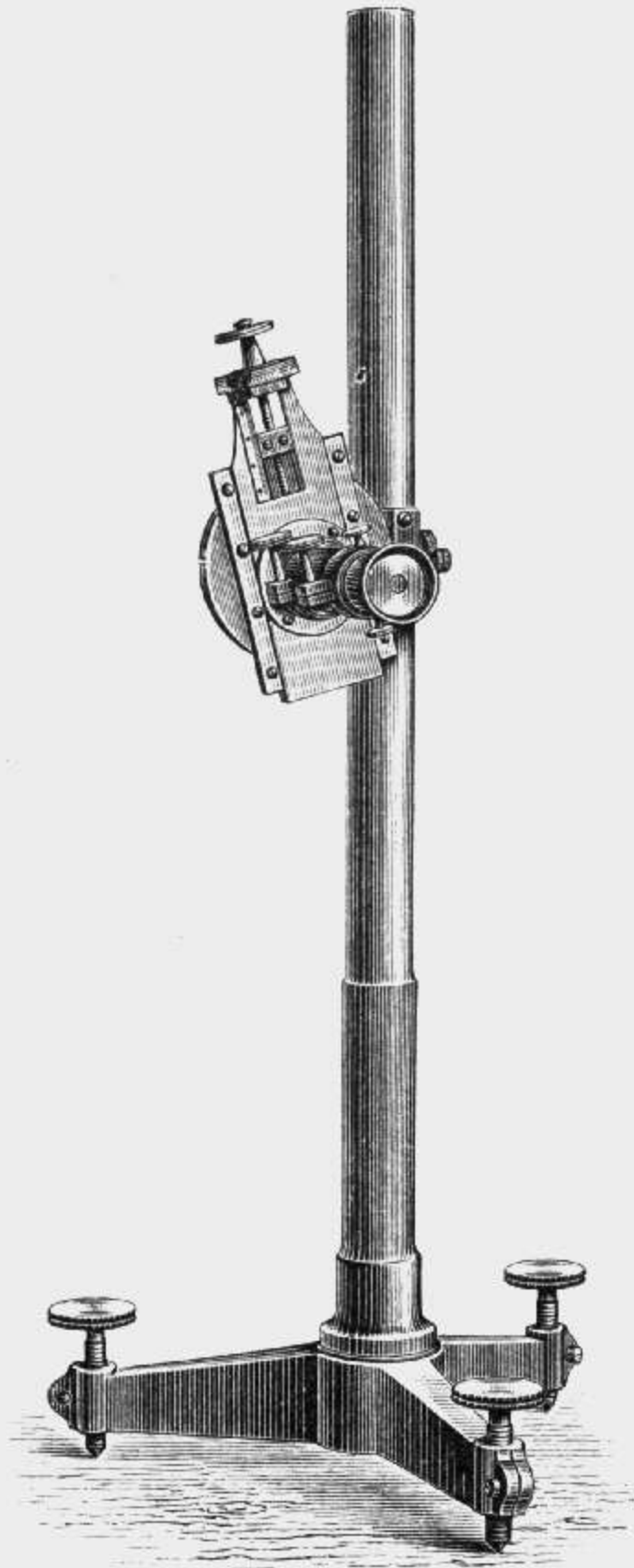
*The telescopes of these instruments can be provided with a*

0271. **Screw Micrometer** with movable thread for the price of . 60

0275. **Fraunhofer's Screw Micrometer,** measuring  
30 millim. in length, reading to  $\frac{1}{200}$  millim. (fig.). . . . 160

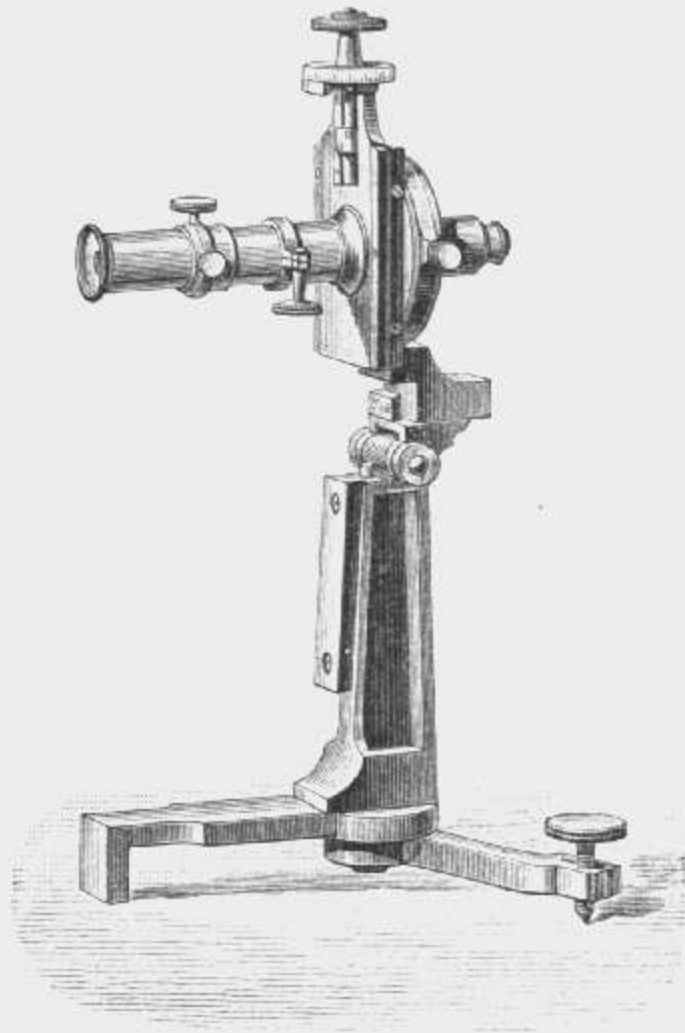


0275.

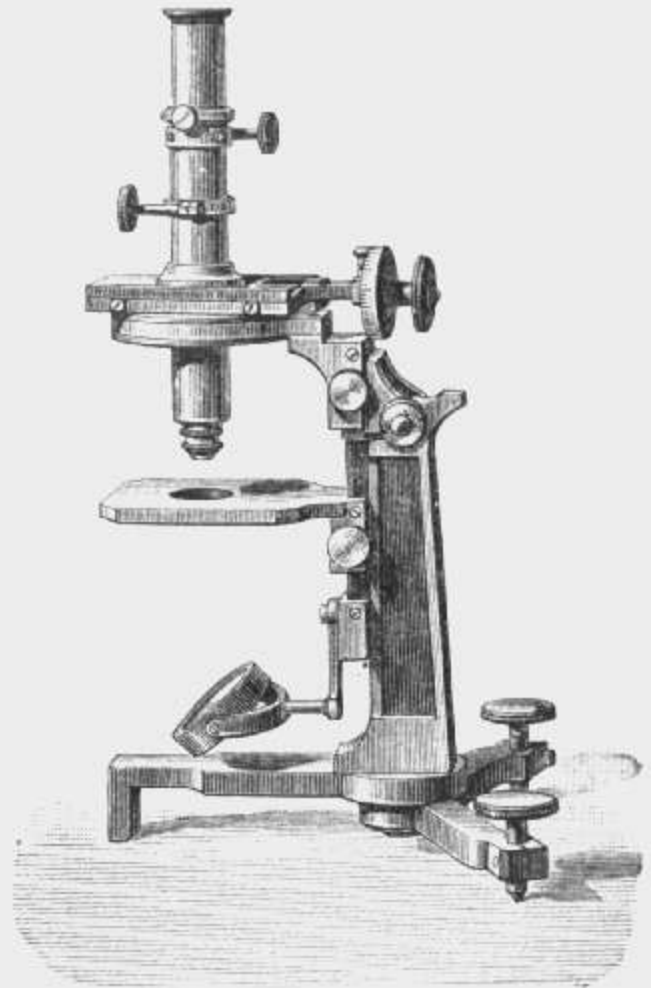


0276.

Nos	Frans.
0276. <b>Fraunhofer's Screw Micrometer</b> with telescope or microscope of low power. The instrument is mounted on a brass column and provided with a turning movement in a vertical plane, so that measurements can be taken in all directions. Cast iron tripod ( <i>fig.</i> ) . . . . .	220
0277. <b>Do.</b> Micrometer provided with a turning movement like the preceding, so that it can be used vertically ( <i>fig. a</i> ) and horizontally ( <i>fig. b</i> ); the micrometer can change places with the shelf; the instrument may thus serve as microscope with micrometric shelf. The tripod folds up. Box for the instrument .	350

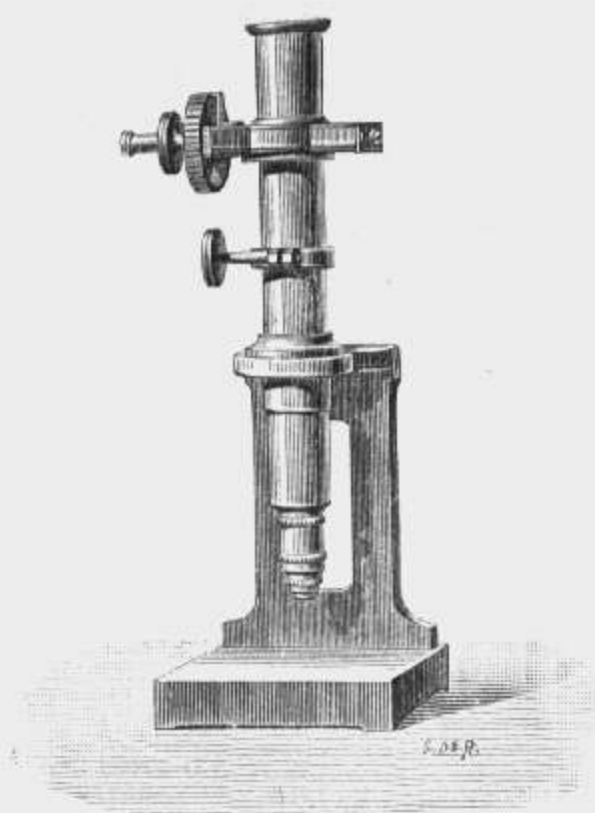


0277 a.

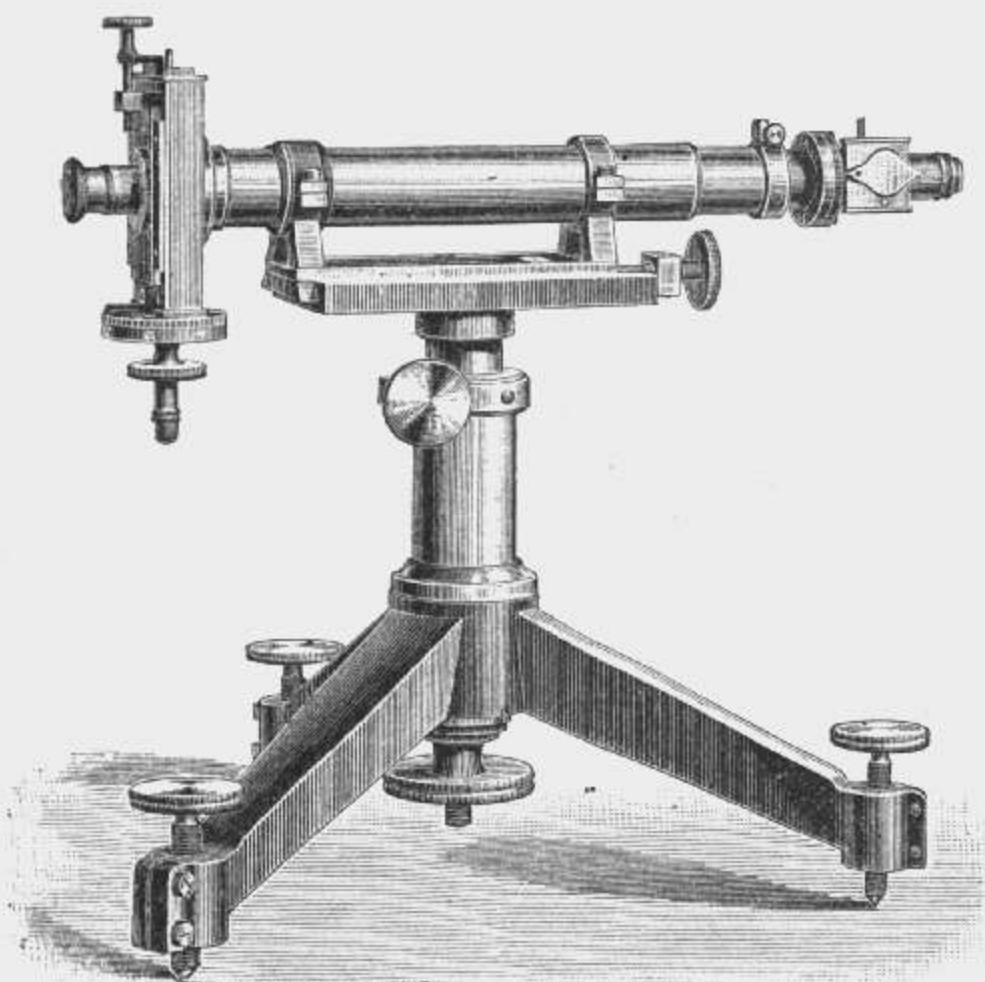


0277 b.

0280. <b>Micrometer Microscope</b> with a movable thread at the focus of the ocular for subdividing the spaces on a graduated bar. Ocular field about 9 millim. Magnifies 30 to 40 times .	100
0285. <b>Do.</b> mounted on a stand as shown in the figure .	135



0285.

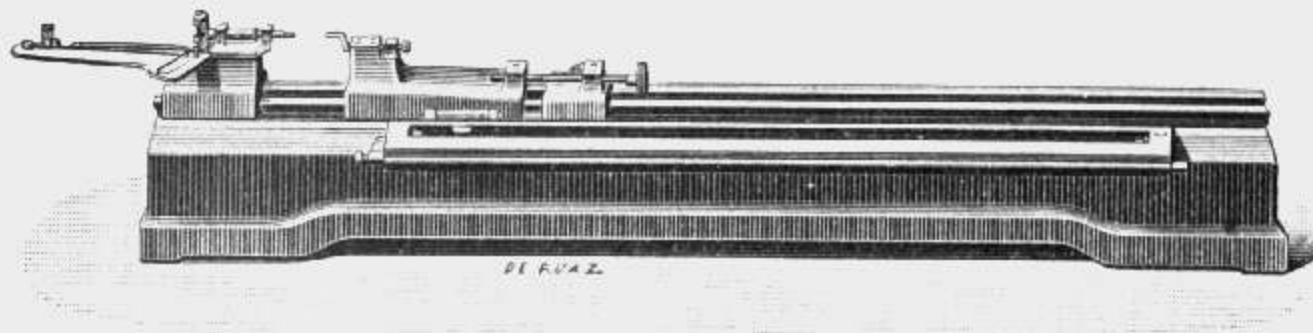


0295.

Nos	Francs.
0290. <b>Micrometer Microscope</b> , larger model for measuring a length of 14 millim. in the focal plane. The eye-piece is regulated by a special screw with coarse thread to keep the image in the centre of the field. Sliding objective to vary the magnifying power. Total length from the object-glass to the focal plane, about 25 centim. Magnifies, unless otherwise specified, about 40 times. . . . .	200
0295. <b>Micrometer Microscope</b> of larger dimensions mounted on a triangular foot as in the figure. The adjustment of the instrument is obtained within the limits of about 20 millim. by a vertical and horizontal regulating screw. Illuminated through the objective by a glass lamella inclined at $45^\circ$ ; three oculars. . . . .	380
<b>Microscopes</b> , see <i>Optics</i> , § 23, 24 and 25.	
<b>Micrometers</b> , see also <i>Astronomy</i> , § 19.	

### § 03. Measuring Machines. Various Compasses and Dividers.

0300. **Machine for measuring** lengths with accuracy up to 50 centim. Approximation  $\frac{1}{100}$  millim. (*fig.*).

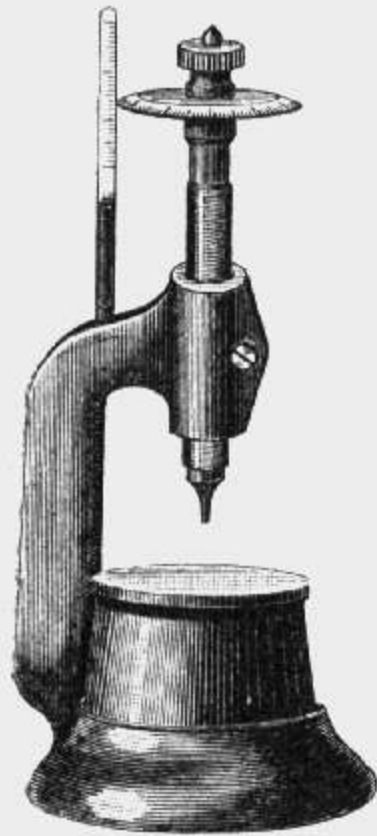


0300.

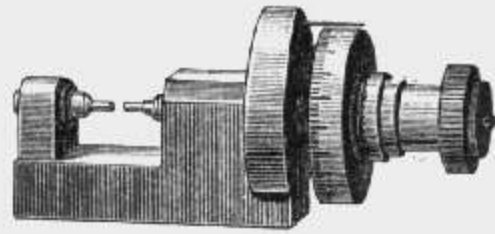
A carefully erected cast iron bench bears in one part a carriage with regulating screw, in the other a movable counterpoint, resting on amplifying levers, securing a constant pressure and the invariability of the zero point. Readings are made by means of a vernier and a magnifying glass, on a standard metre divided into fifths of a millim. . . . .

600

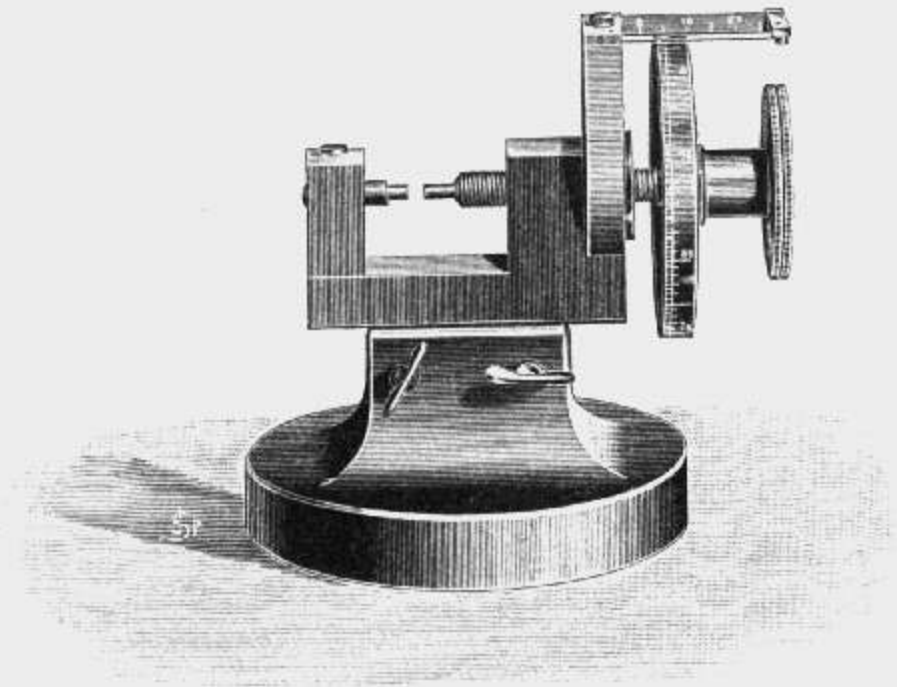
Nos		Francs.
0305.	<b>Calliper with Micrometer Screw</b> , millimetric thread, reading to $\frac{1}{100}$ millim. by a graduated circle; measuring 35 millim. ( <i>fig.</i> ) . . . . .	35
0306.	<b>Do.</b> with spring to exert a uniform pressure on the object measured . . . . .	45



0305.

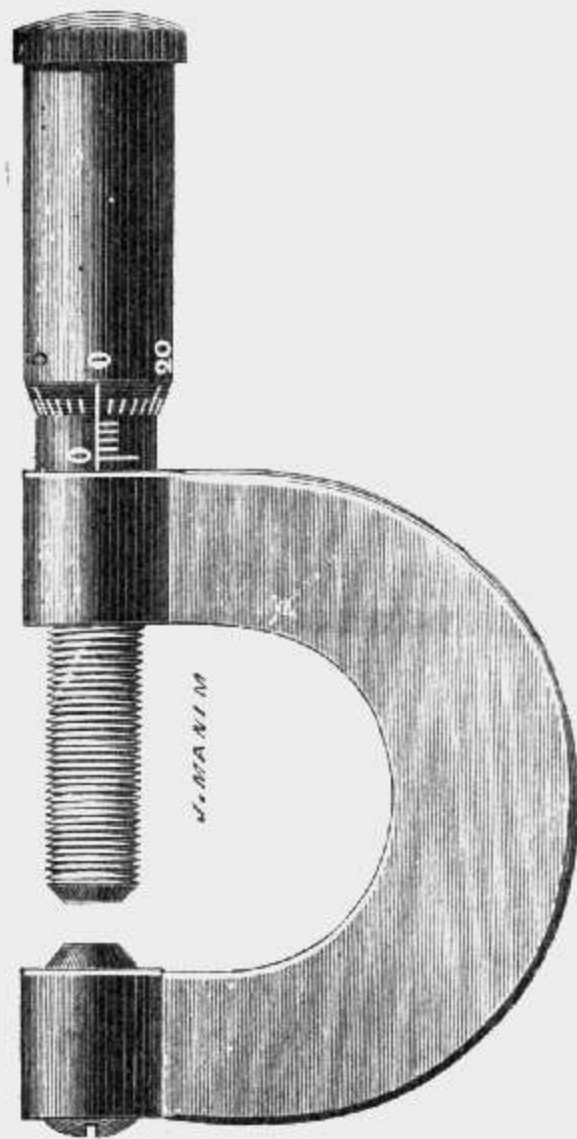


0310.

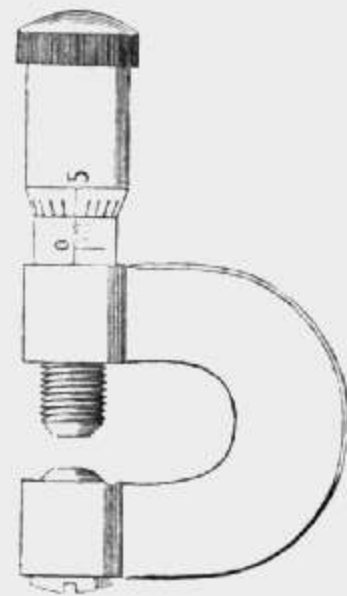


0312.

Nos		Francs.
0310.	<b>Calliper with Micrometer Screw</b> , of bronze, reading to $\frac{1}{100}$ millim.; dimensions according to the figure; measuring 10 millim. ( <i>fig.</i> ) . . . . .	25
0311.	<b>Calliper with Micrometer Screw</b> and ratchet head, to exert a uniform pressure on the object measured. . . . . Mounted on a cast iron foot 3 fr. more.	35
0312.	<b>Do.</b> larger size for measuring with an approximation of $\frac{1}{200}$ millim. ( <i>fig.</i> ) . . . . .	50
0315.	<b>Palmer's Screw Calliper</b> , of steel, opening 30 millim., approximation $\frac{1}{20}$ millim. . . . .	25
0316.	<b>Do.</b> of steel, opening 15 millim.; approximation $\frac{1}{100}$ millim. . . . .	22
0317.	<b>Do.</b> of bronze ( <i>fig.</i> ). Opening 25 millim.; in a case. . . . .	18



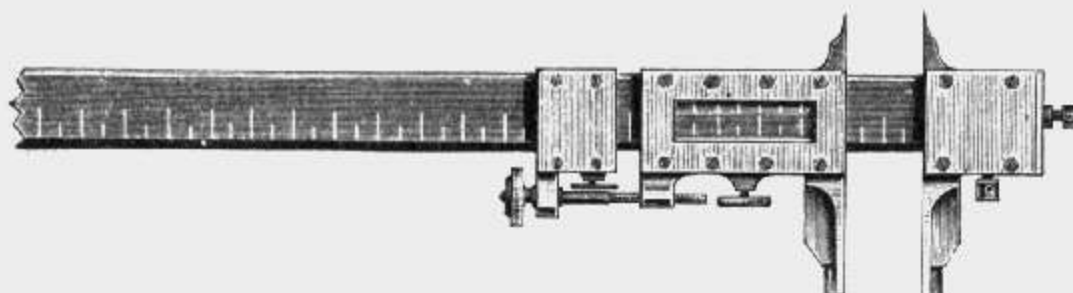
0317.



0318.

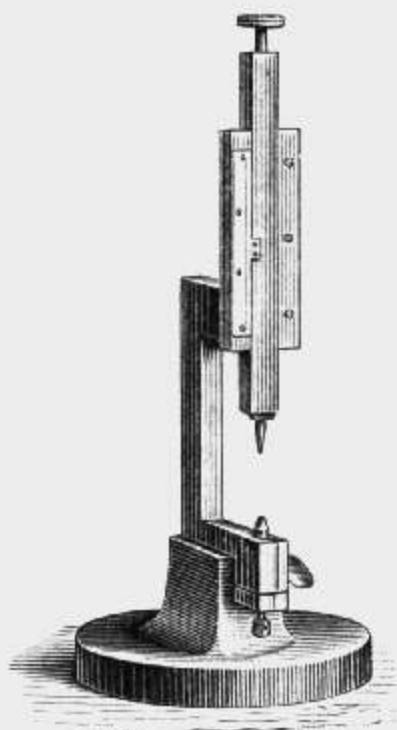
0318.	<b>Palmer's Screw Calliper</b> , of bronze ( <i>fig.</i> ) Opening 10 millimetres. . . . .	15
-------	--	----

Nos	Francs.
0320. <b>Slide Calliper</b> of precision, for measuring up to 270 millim. in length, divided into $\frac{1}{5}$ millim., approximation $\frac{1}{100}$ millim. by a vernier ( <i>fig.</i> ) . . . . .	120



0320.

0321. <b>Do.</b> of German silver, 25 centim. long, with vernier and regulating screw, reading to $\frac{1}{20}$ millim . . . . .	50
0325. <b>Slide Calliper Pin-footed</b> , for drawing, of steel, 30 centim. long, divided into millim. with vernier reading to $\frac{1}{20}$ millim. ( <i>fig.</i> ) . . . . .	40
0326. <b>Do.</b> with regulating screw . . . . .	45

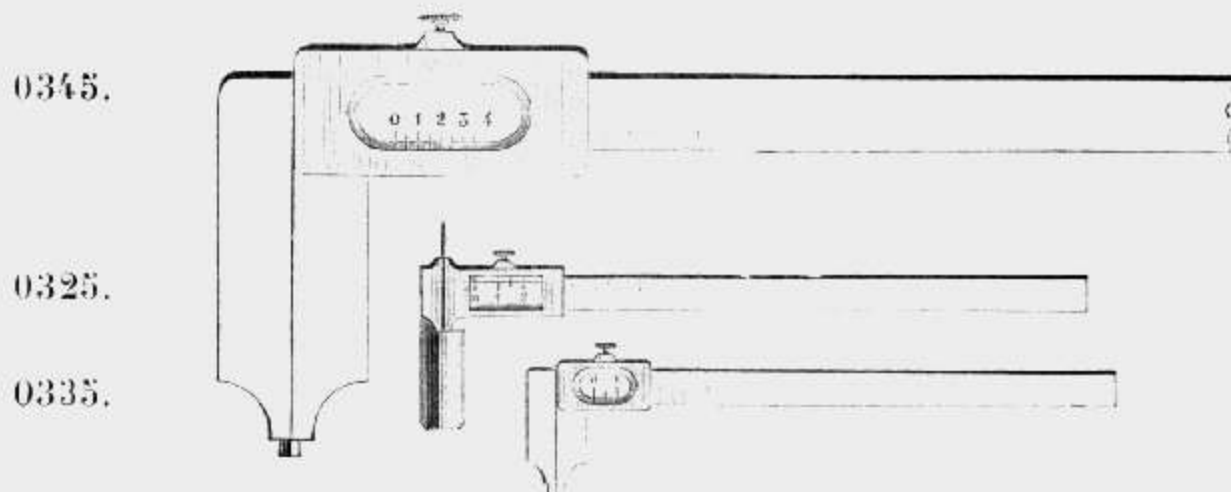


0330.

0330. <b>Slide Calliper on Stand</b> , measuring up to 45 millim. with an approximation of $\frac{1}{50}$ or $\frac{1}{100}$ millim. and designed to be used horizontally or vertically ( <i>fig.</i> ) . . . . .	60
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Nos		Francs.
	The difference between the tool for $\frac{1}{50}$ and the tool for $\frac{1}{100}$ consists in the division to $\frac{1}{50}$ being larger and consequently easier to read, whereas the division to $\frac{1}{100}$ must be finer and require more attention in reading.	
0335.	<b>Mechanician's inside Calliper</b> , of steel. — Very useful size 25 centim. long, scale divided into millim., vernier reading to $\frac{1}{10}$ millim., length of nibs 45 millim. The tips are tempered and worked out exactly 10 millim. thick, which allows of taking inside measurements with accuracy. ( <i>fig.</i> )	25
0336.	<b>Do.</b> same construction as the preceding; the cursor is adjusted in such a way that it can be turned end to end for the measurement of heights. Scale on both sides . . .	35
0340.	<b>Small Pocket Calliper</b> , measuring 10 centim., with vernier reading to $\frac{1}{10}$ millim. . . . .	20
0345.	<b>Large Calliper</b> of steel, for the workshop, divided into millim. with an allowance for the shrinking of cast iron and brass ( <i>fig.</i> ); scale 50 centim. long, nibs 125 millimetres . . .	100

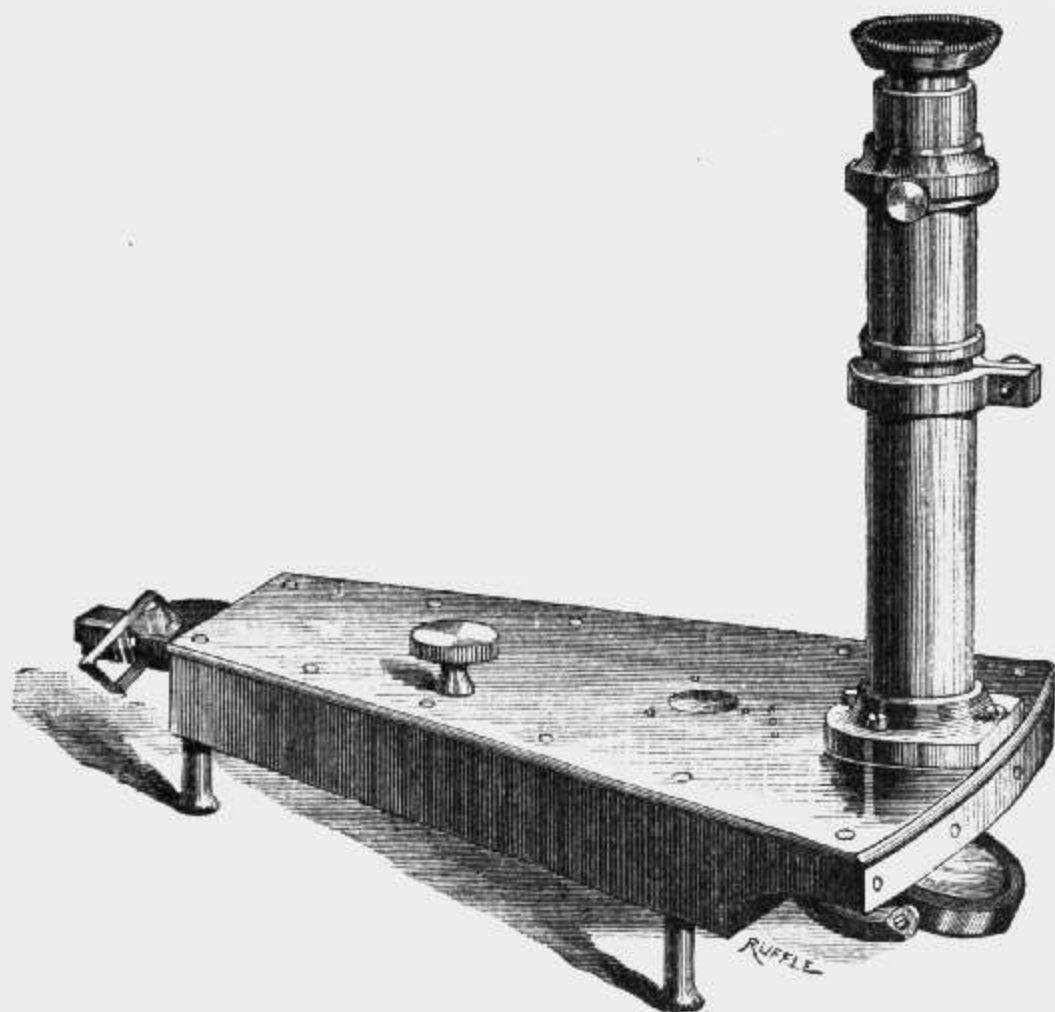


0346.	<b>Do.</b> 1 metre long; nibs 160 millim. . . . .	150
0350.	<b>Compass reading to <math>\frac{1}{500}</math> or <math>\frac{1}{1000}</math> millim.</b> — This instrument permits the measuring of objects 3 millim. thick. The amplification is obtained by a lever and a microscope having at its focus a glass micrometer ( <i>fig.</i> ) . . . . .	300
0355.	<b>Double Compass, called twelfths' Measure.</b> Frequently employed in watchmaking. The scale is divided	

Nos

Francs.

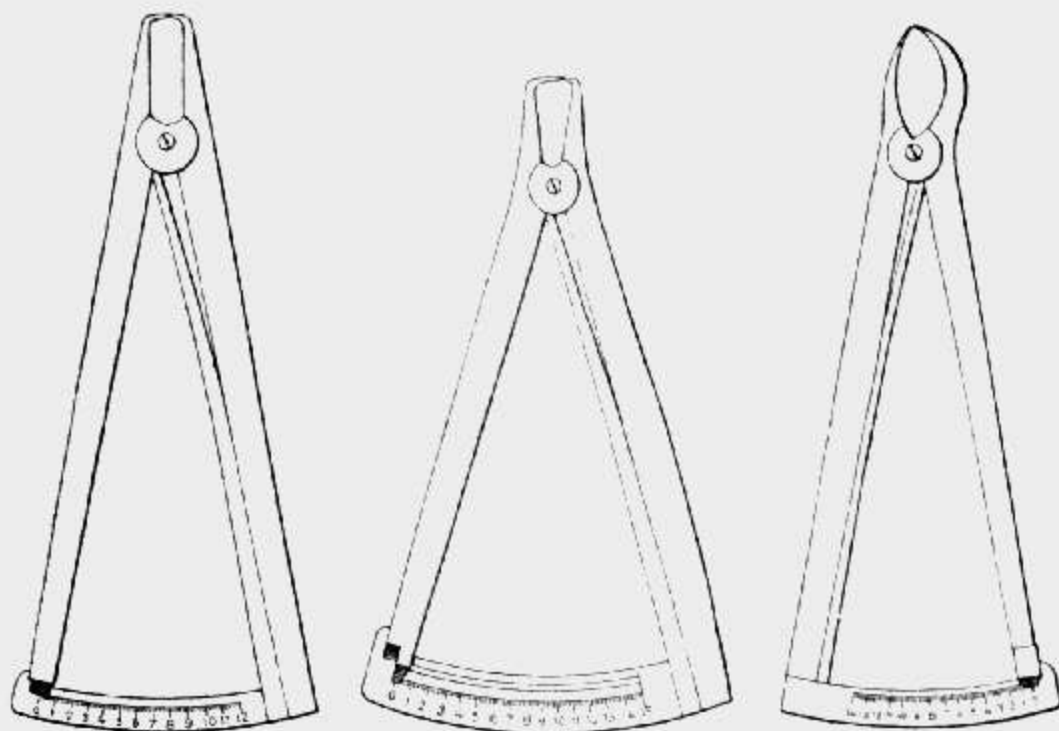
on one side into fifths of millim. and on the other into  $\frac{1}{12}$  of lines. Measures up to 12 millim. The scale corresponds exactly to the chord contained between the tips of the tool; these tips may be symmetrical or different (*fig.*) . . . . . 14



0350.

- 0360. **Double Compass**, symmetrical nibs, similar to preceding, stronger construction (*fig.*) . . . . . 16  
 The tool is divided on one side into  $\frac{1}{24}$  of a line and into  $\frac{1}{19}$  of a millim.
- 0365.       **Do.**           with symmetrical points, reading to  $\frac{1}{10}$  or  $\frac{1}{20}$  millim. (*fig.*) . . . . . 16
- 0370. **Caliber Blocks**, for very slight thicknesses. These blocks are thin glass or steel lamellae, gauged with an approximation of  $\frac{1}{100}$  millim. The gauge is marked by a small engraved circle: each . . . . . 3
- 0375.       **Do.**           of steel. These blocks are small cylinders 10 millim. in diameter, of tempered steel, with parallel

Nos	Francs.
bases at a given distance, and gauged with an approximation of about $\frac{1}{100}$ millimetre; each . . . . .	10
0376. <b>Caliber Blocks.</b> Gauged to $\frac{1}{50}$ millim., each . . . . .	5



0365.

0360.

0355.

0380. **Cylindrical Calibers**, for inside and outside measurements, gauged exactly according to a given measure; for small dimensions, in steel; cast iron for large dimensions. Price according to exactness and dimensions required.

0385. **Ordinates Compass** . . . . . 500

It is often very difficult to determine the shape of a body of irregular outline; the apparatus fills up this gap. The body to be measured is held if necessary, by special plyers. Two touch buttons measure the transversal dimensions at different places and directions. The readings are made with an approximation of  $\frac{1}{10}$  millim. Price varies with the construction.

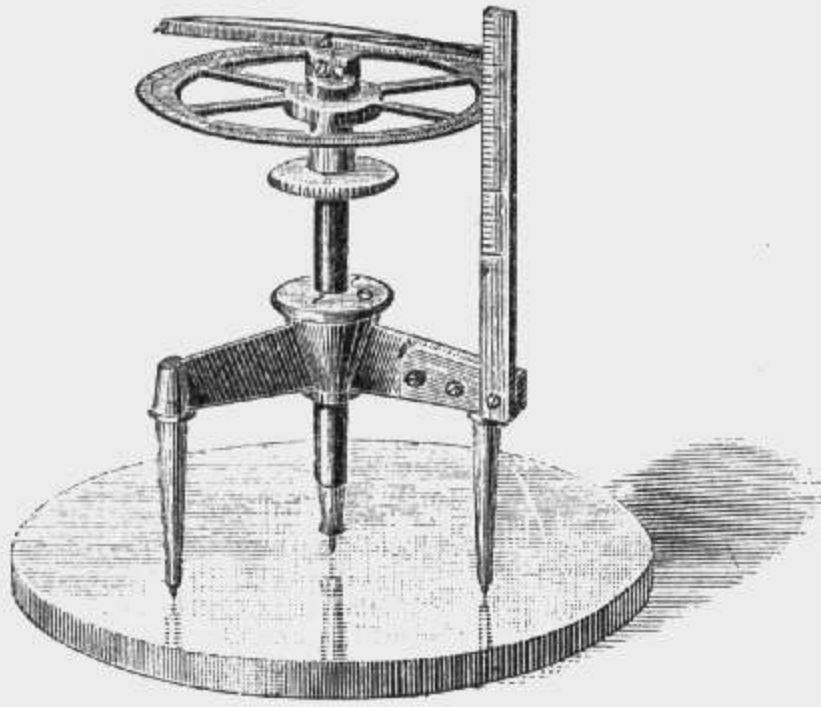
0390. **Spherometer** with micrometer screw and double index lever (*fig.*). The thread of the screw is  $\frac{1}{2}$  millim. and the horizontal circle is divided into 500 equal parts.

With the glass stand . . . . . 135

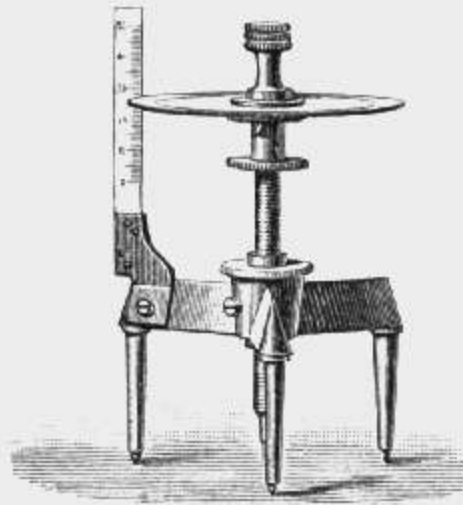
0395. **Do.** of smaller dimensions than the preceding without index lever (*fig.*) . . . . . 80

Nos

Francs.



0390.

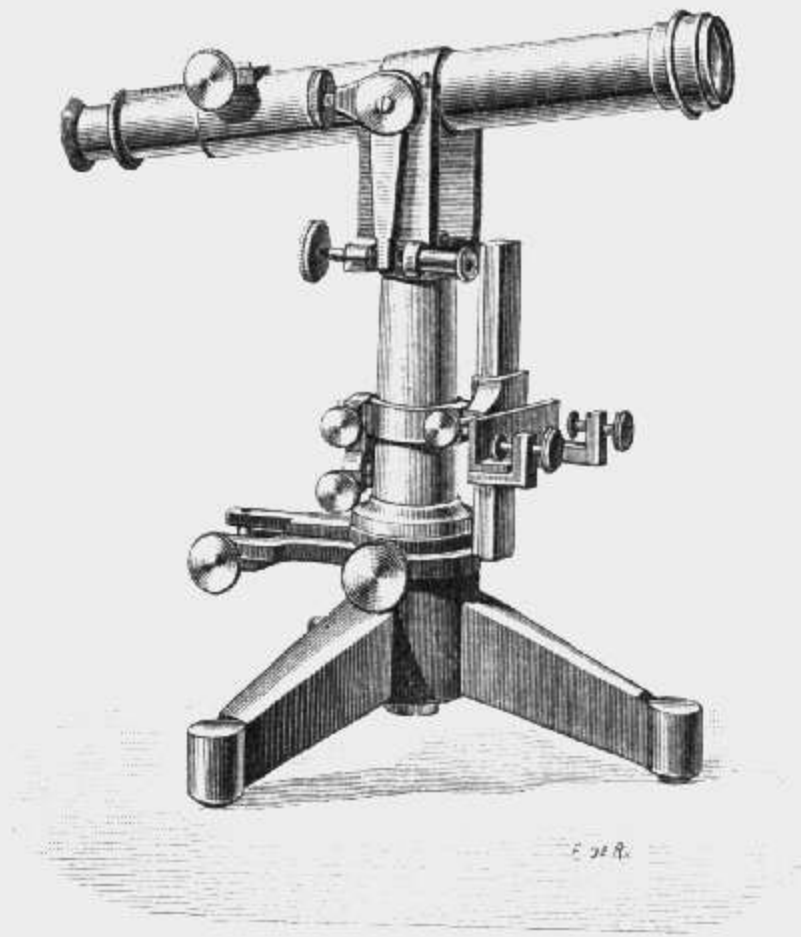


0395.

§ 04. Measurement of Angles, Areas and Volumes.

0400.	<b>Protractor</b>	with glass centre and alidade reading to 2 minutes, 18 centim. in diam. . . . .	40
0401.	<b>Do.</b>	25 cent. in diam., reading to 1 min. . . . .	50
0402.	<b>Do.</b>	30       »       »       »       »       »       » . . . . .	60
0403.	<b>Do.</b>	with complete circle 25 centim. in diam. . . . .	60
0404.	<b>Do.</b>	with cog-wheels . . . . .	80
0405.	<b>Straight Vernier</b>	in wood, lecture room model . . . . .	10

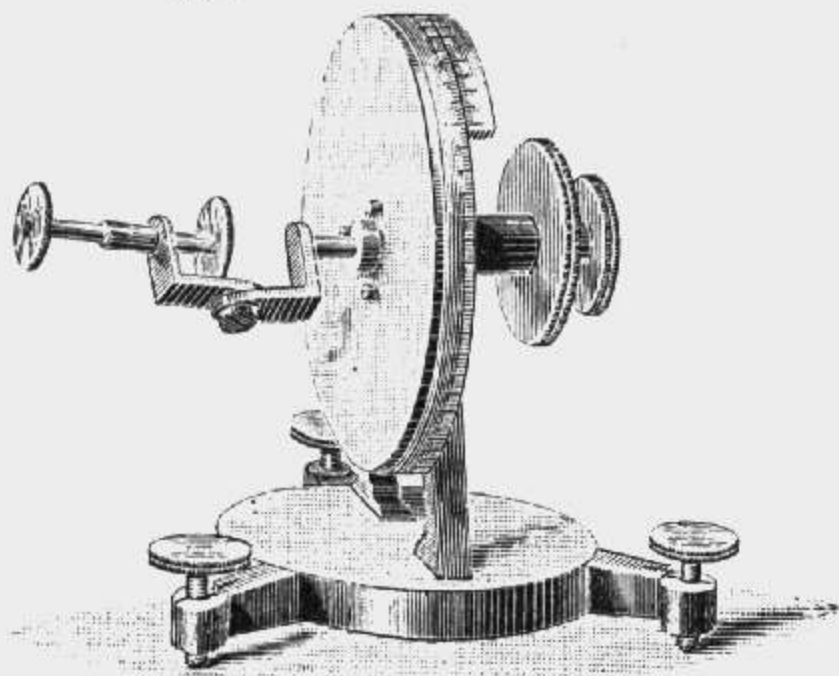
Nos		Francs.
0406.	<b>Circular Vernier</b> , lecture room model . . . . .	15
0410.	<b>Pointing Telescope.</b> The telescope is mounted on a round brass column, without scale, 35 millim. in diameter, and 115 centim. high; the telescope can be pointed in all directions. . . . .	140
0415.	<b>Do.</b> same model, column 65 centim. high . . . . .	120
0416.	<b>Adjunction of a lens in front of telescope for short distances</b> . . . . .	12
0420.	<b>Pointing Telescope</b> with graduated paper scale to observe mirror instruments, 27 millim. aperture ( <i>fig.</i> ) . . . . .	140
0421.	<b>Do.</b> 33 " " . . . . .	180
0422.	<b>Do.</b> 40 " " . . . . .	220



0420.

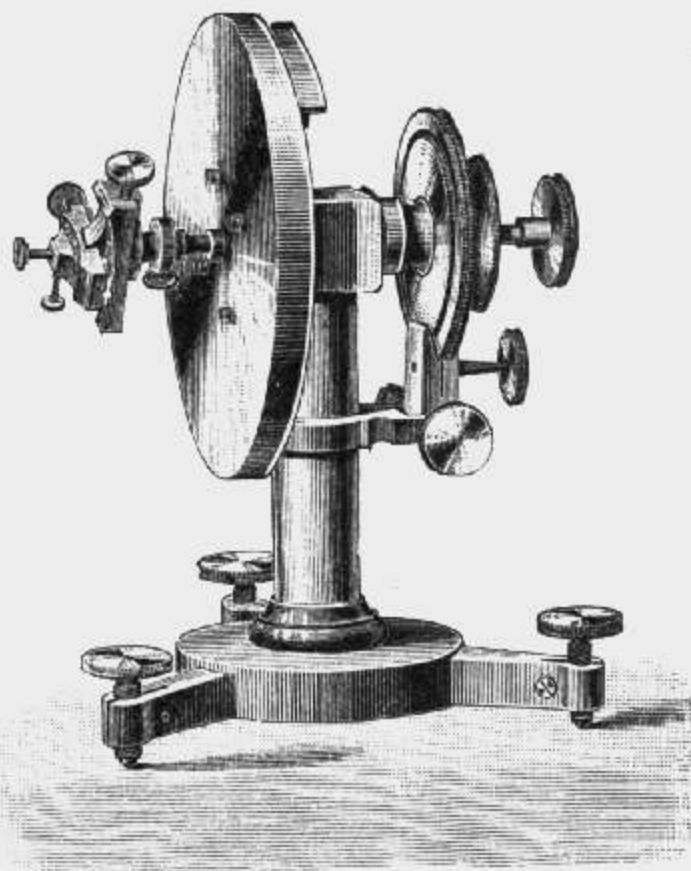
0423.	<b>Do.</b> of plainer construction. Telescope of 27 millimetres aperture . . . . .	120
0425.	<b>Haüy's Goniometer</b> , model without hinges . . . . .	35
0426.	<b>Do.</b> model with hinges . . . . .	50

Nos	Francs.
0430. <b>Wollaston's Goniometer</b> for measuring the angles of crystals, on a stand with three levelling screws, vernier reading to one minute ( <i>fig.</i> ) . . . . .	100



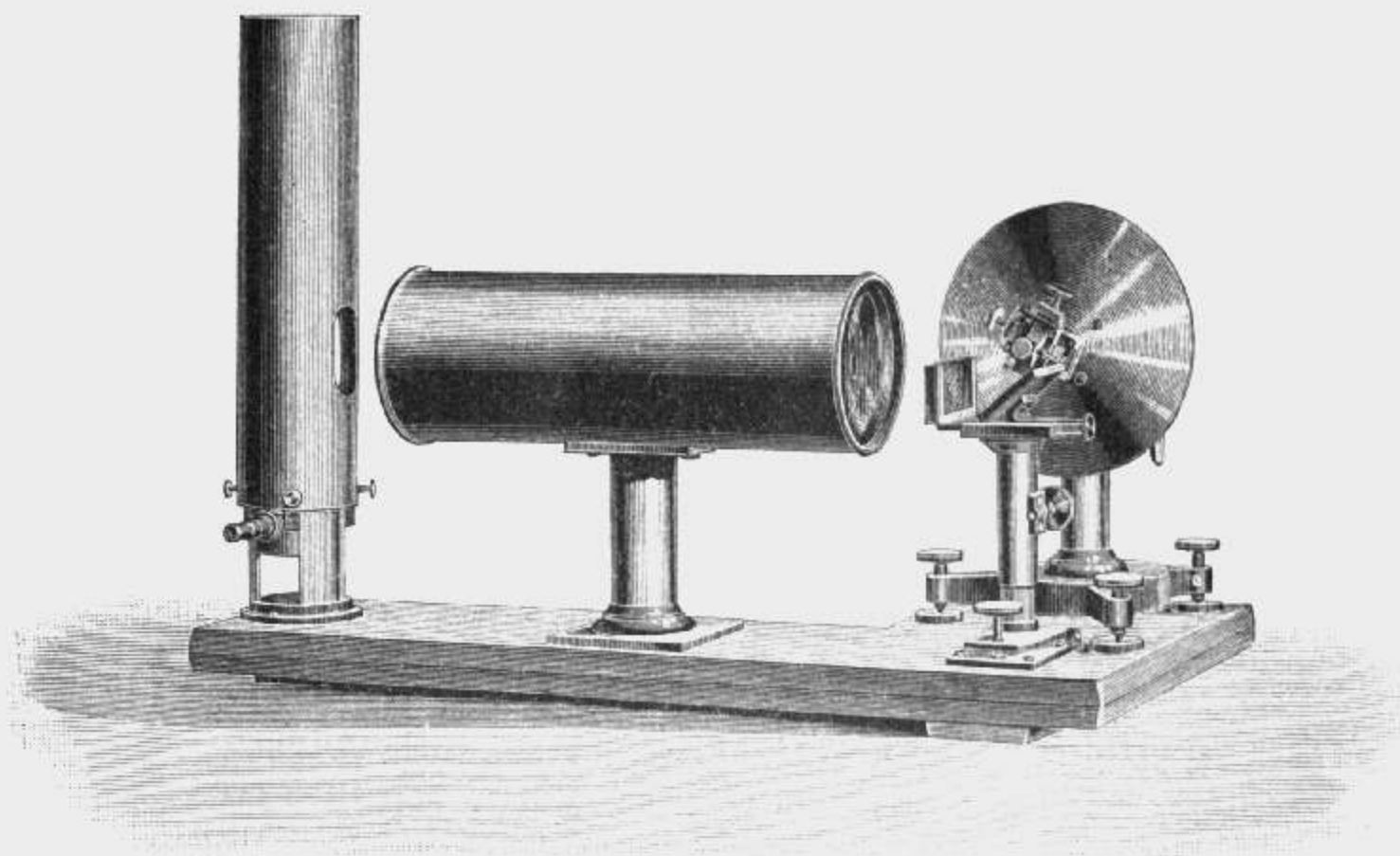
0430.

0431. <b>Adjunction</b> of a black mirror on the foot of the instrument .	15
0435. <b>Wollaston's Goniometer</b> , larger model, circle 140 millimetres in diameter, with regulating screw, apparatus for centering crystals and vernier reading to 30 seconds ( <i>fig.</i> ) .	230



0435.

Nos	Francs.
0436. <b>Wollaston's Goniometer</b> improved by <b>Mallard</b> . Same model as preceding with the addition of a collimator with slit of various forms and an adjustable support for the black mirror ( <i>fig.</i> ) . . . . .	380



0436.

0440. <b>Babinet's Goniometer</b> , classical model with circle 180 millimetres in diameter; vernier reading to one minute with prism ( <i>fig.</i> ). . . . .	220
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This instrument being provided with complete telescopes may be used without modification as spectrometer.

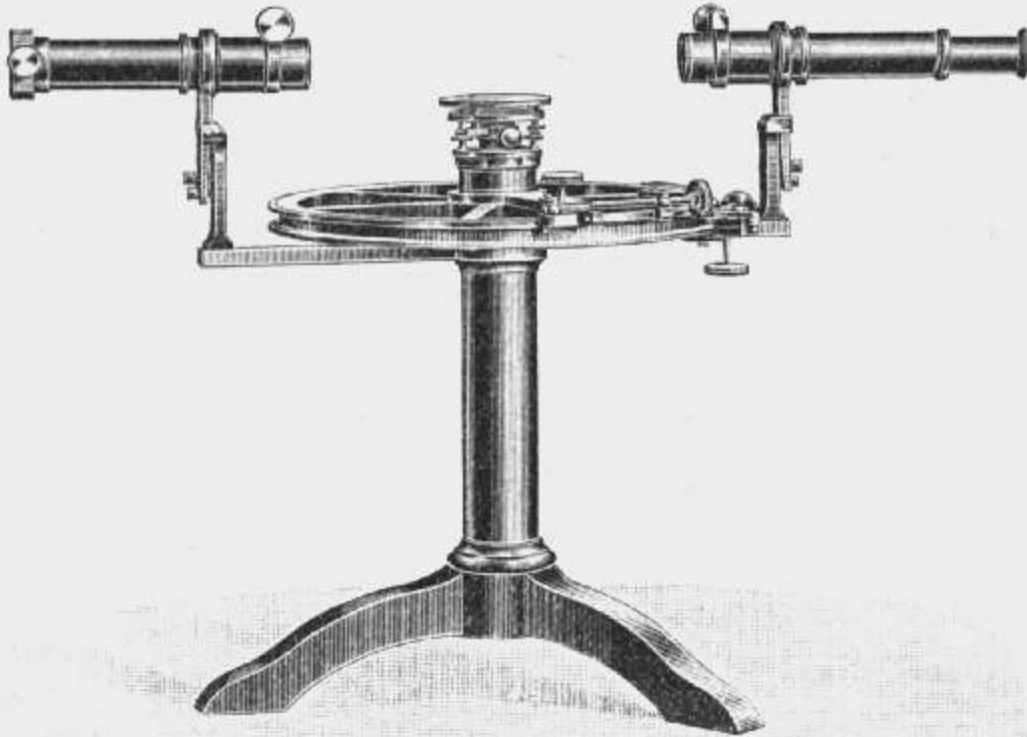
0445. <b>Reflection Goniometer</b> . Large model with circle 230 millimetres in diameter divided on silver and reading to 10 seconds by two verniers. The circle and the observing telescope have each an independent movement round the central axis and are provided with regulating screws. Measurements can thus be taken in the two following manners: 1. by clamping the circle, which bears the crystal and moving the telescope alidade; 2. by clamping the telescope alidade and moving the circle with the crystal. Centering apparatus after Fuess. The apparatus is provided with several oculars and several slits for	
---	--

Nos

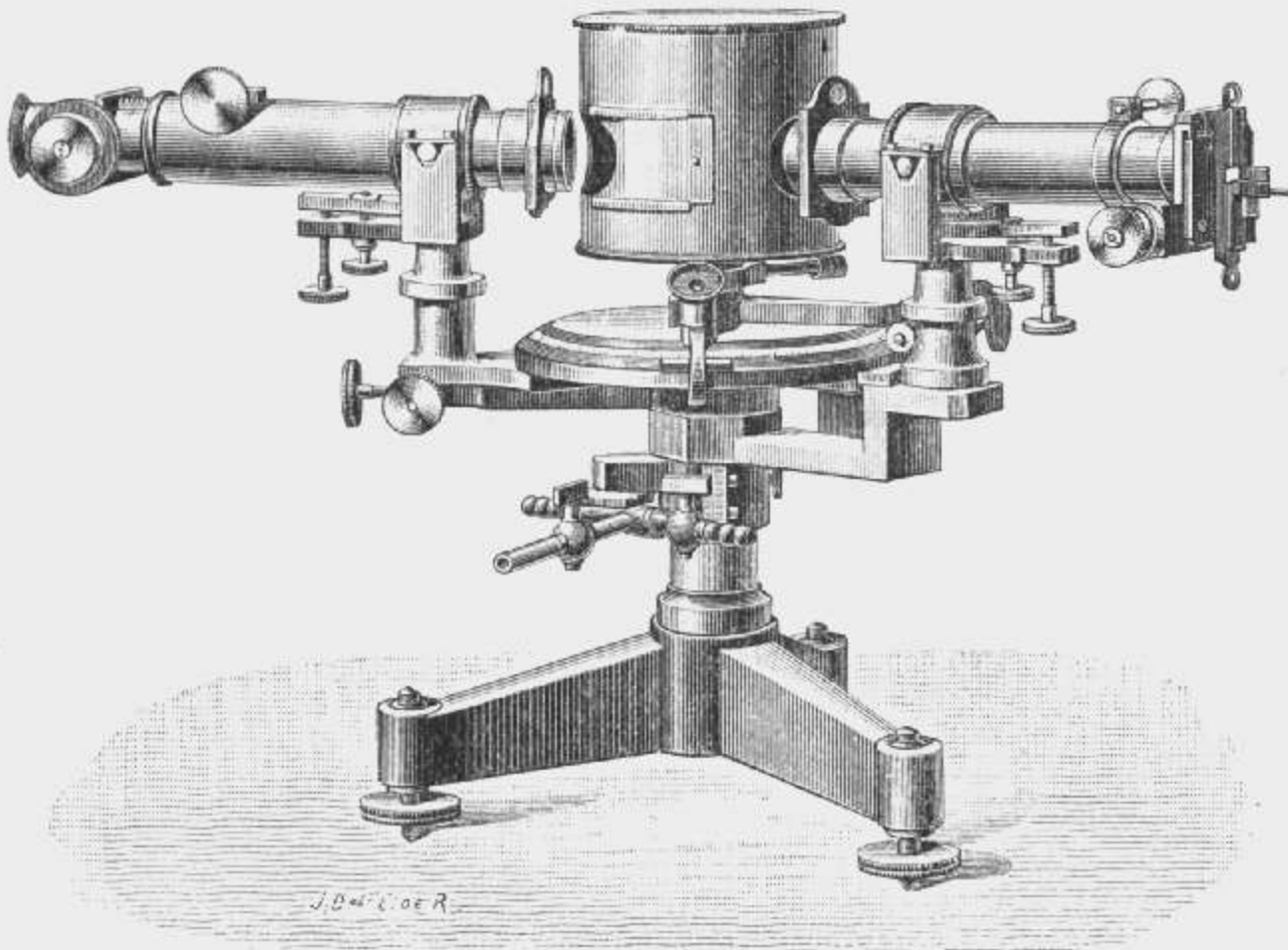
Francs.

the collimator; the observing telescope is provided with a complementary objective for the adjustment of objects to be examined . . . . .

950



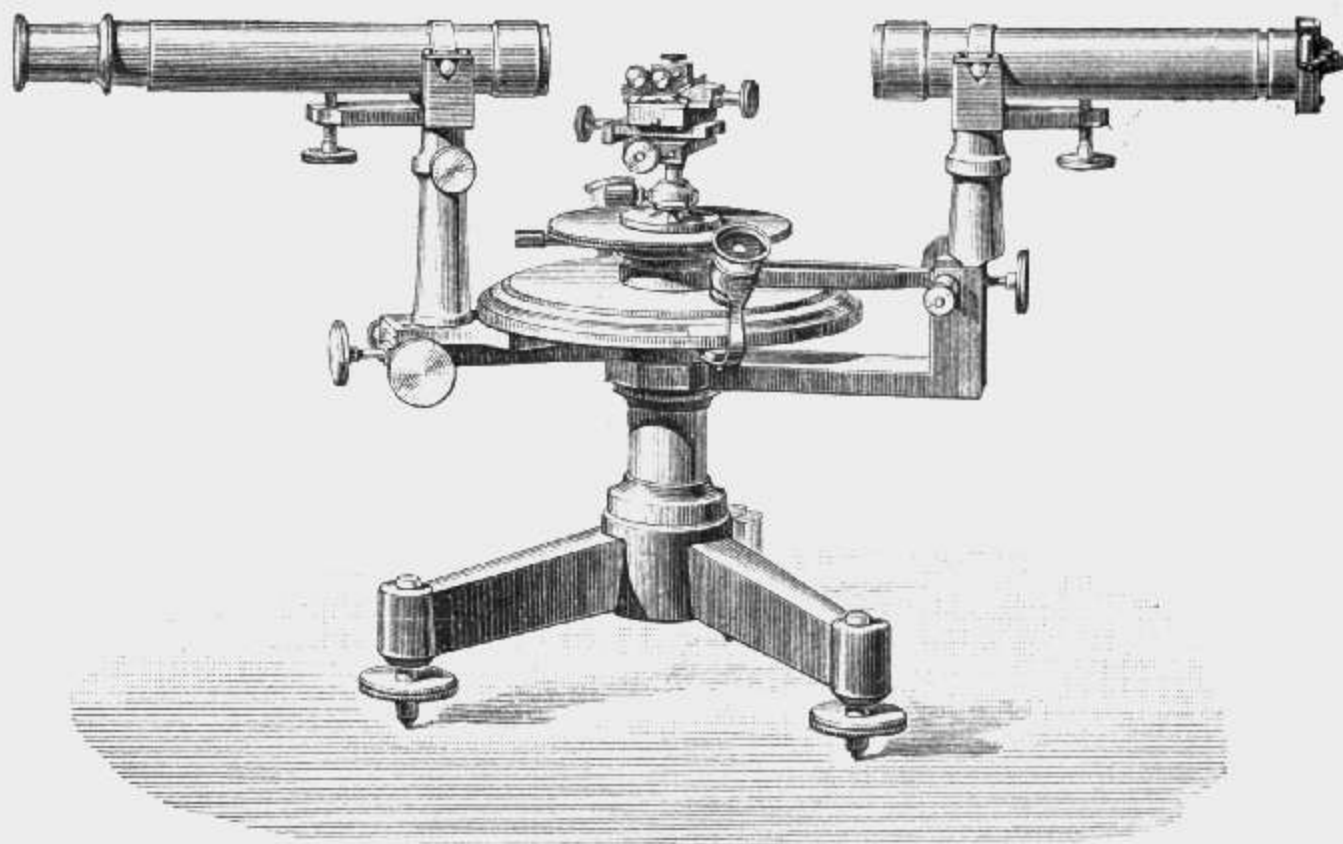
0440.



0450.



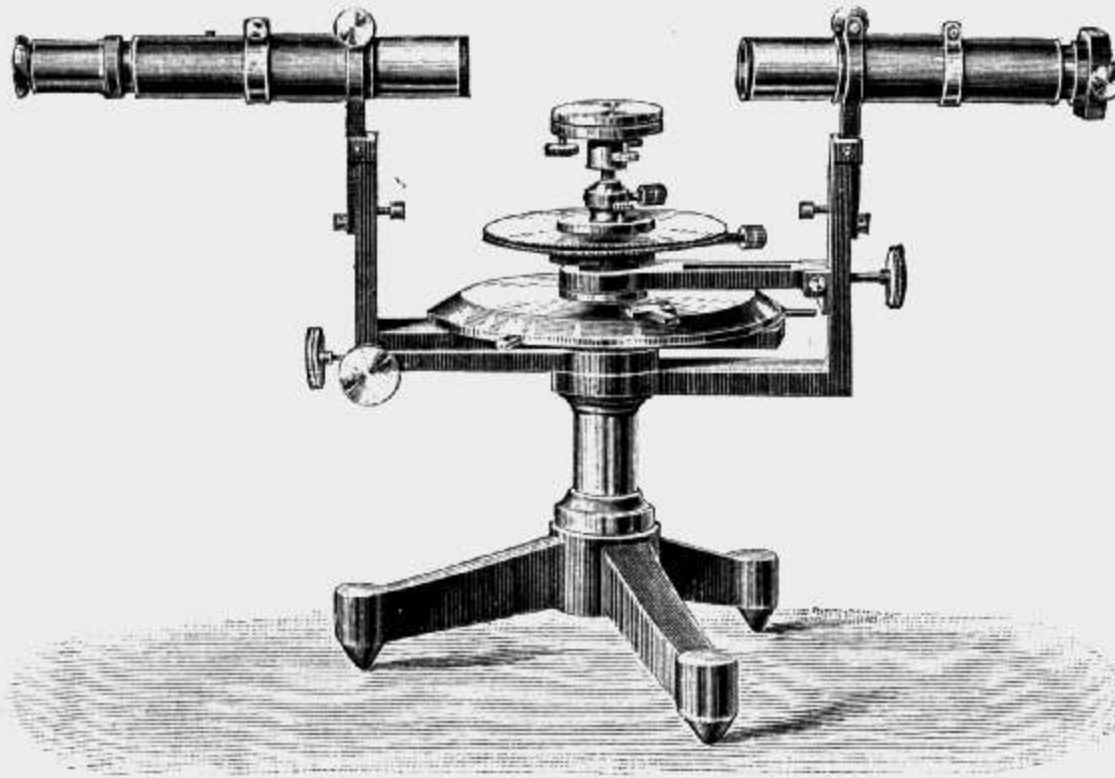
Nos		Francs.
0450.	<b>Reflection Goniometer.</b> Model like preceding; circle 150 millim. in diameter, reading to 20 seconds. Telescope 27 millim. aperture. Designed to be used also as spectroscope. With an ocular micrometer or a scale telescope ( <i>fig.</i> ) . . .	550
0451.	<b>Do.</b> without the ocular micrometer . . . . .	500
0455.	<b>Do.</b> laboratory size with circle 15 centim. in diameter, divided into thirds of degrees, verniers reading to 30 seconds, telescope 22 millim. aperture ( <i>fig.</i> ). . . . .	285
0456.	<b>Adjunction</b> to the three preceding models of a support for centering crystals . . . . .	75
0457.	<b>Adjunction</b> of a complementary objective facilitating the adjusting of the crystal . . . . .	20
0460.	<b>Reflection Goniometer,</b> student model; divided on brass into $\frac{1}{2}$ degrees, vernier reading to one minute ( <i>fig.</i> ) . . . . .	200
0465.	<b>Amsler's Planimeter</b> . . . . .	80
0480.	<b>Standard Liter</b> of brass, graduated. . . . .	15
0490.	<b>Regnault's Volumenometer</b> . . . . .	110



0455.

Non

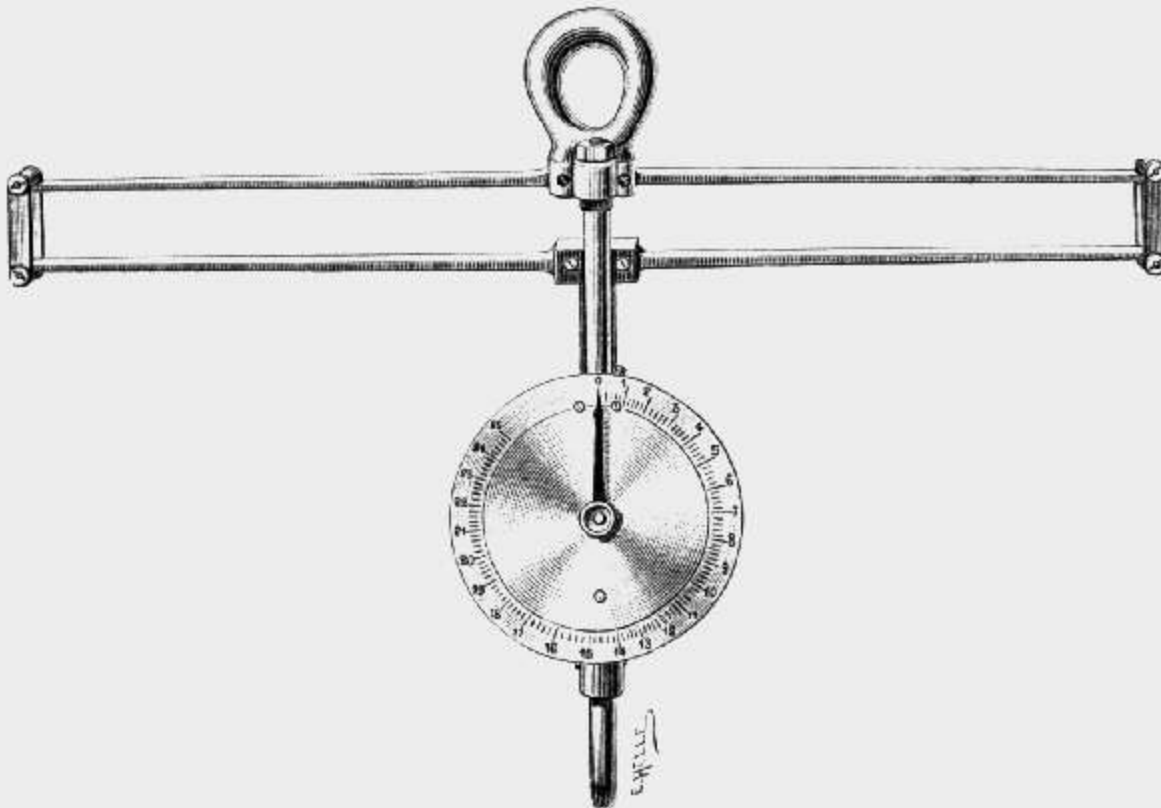
Francs.



0460.

§ 05. Dynamometers.

0500. **Poncelet's straight Spring Dynamometer.** Circular dial indicating up to 25 kilogr. (*fig.*) . . . . . 100

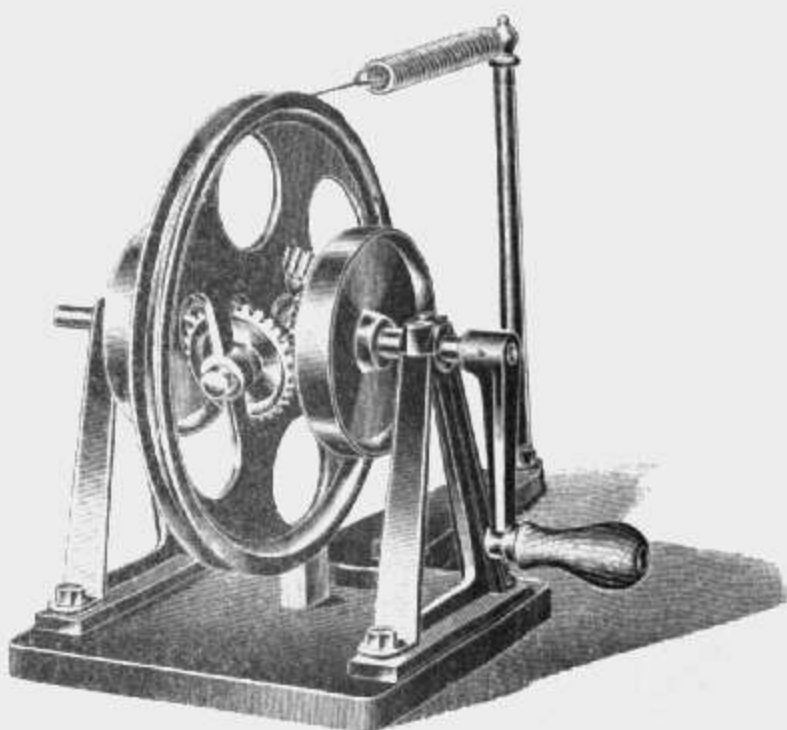


0500.

Nos	Francs.
0510. <b>Spring Balance or Dynamometer</b> , with helicoidal spring, designed also for the lecture room and measuring up to $\frac{1}{2}$ , 1, 2 or 3 kilogr. ( <i>fig.</i> ) . . . . .	15



0510.



0510.

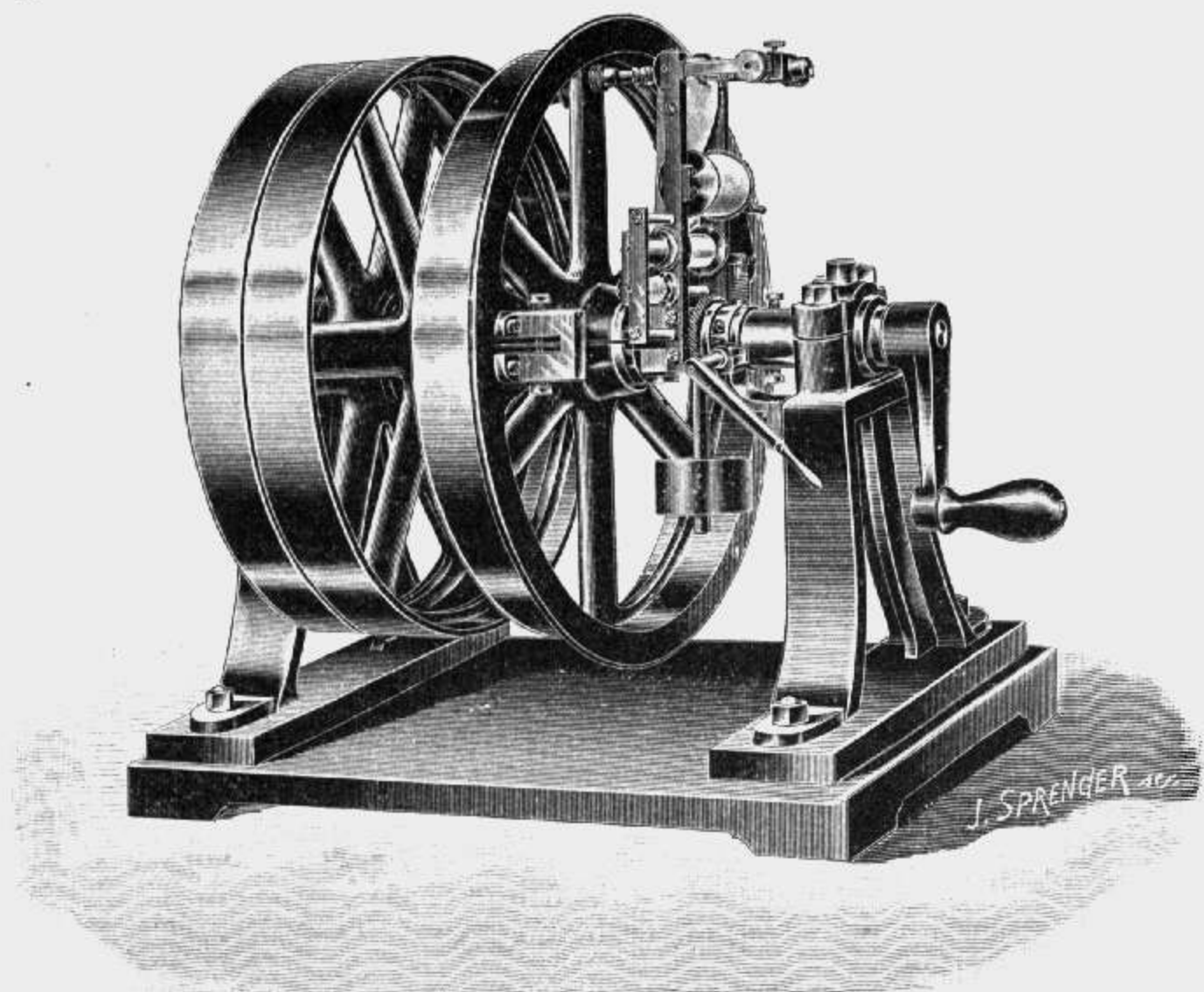
0520. <b>Dynamometer</b> with crank, for lectures . . . . .	100
0530. <b>Morin's Rotary Dynamometer</b> , with registering apparatus ( <i>fig.</i> ) . . . . .	750
0540. <b>White's American Dynamometer</b> with bevel gearing wheels ( <i>fig.</i> ) . . . . .	150

### § 06. Analytical Scales. Standard Weights.

The « Société Genevoise » undertakes, when desired, to get the « Bureau international des Poids et Mesures » to verify the standard weights made in its shops; but it reminds its customers that these comparisons are subject to special regulations, fixed

Nos

Francs.



0530.

by the International Bureau and from which we make the following extracts :

« ART. 2. — The tests to be executed at the International  
 « Bureau must be strictly limited to standards of the highest order.  
 « Orders which do not come from Governments may be addressed  
 « to the Director of the International Bureau, pavillon de Breteuil,  
 « Sèvres (*near Paris*). But they are submitted in all cases to the  
 « Board, which decides whether they can be accepted and gives  
 « the necessary authorization. »

« ART. 8. — *Measures of mass.* — The mass or weight standards  
 « and the divisionary weights may be of metal or hard stone. They  
 « must be formed of a single piece, without parts inserted nor inter-  
 « nal cavities, they must be gauged by filing and not by adding  
 « shot. They must be in an irreproachable state of preservation. »

« The owners may claim for these standards :

- « a) the equation with respect to the prototype kilogram, if the vo-  
 « lume or density is given ;
- « b) the determination of the specific weight ;
- « c) for divisionary weights, their value in metrical units. »

« ART. 11. — The tests desired by governments of States, « which have adhered to the Convention of the Metre, are made « without charge. »

« Public or private institutions, as well as scientific men or con- « structors from States, which participate in the Convention, shall « pay the following fees, as fixed by the Board in virtue of article 15 « of the Regulations annexed to the Convention. »

## II. — DETERMINATION OF MASSES

« Metric weights; maximum 1 kilogram.

« 1. Determining the absolute weight of an object, the specific weight being already known or stated by the owner . . . . .	60
« 2. Determining the specific weight of an object . . . . .	120
« 3. Gauging a series of weights; for each weight in addition to the principal one . . . . .	20

« For weights above 1 kilogram or belonging to other systems, « the fees shall be fixed, as above, in each particular case. »

« Governments of States, which have not adhered to the Con- « vention, as well as their subjects or citizens, shall have to pay « the double of these fees and the Bureau shall take no respon- « sibility in case of delay in the tests. »

« ART. 12. — The owners will have to pay the expenses of « transportation, packing and sending the objects by mail or by « railway. »

« The fees are payable on the delivery of the certificates, or taken « in reimbursement on sending these certificates by mail. »

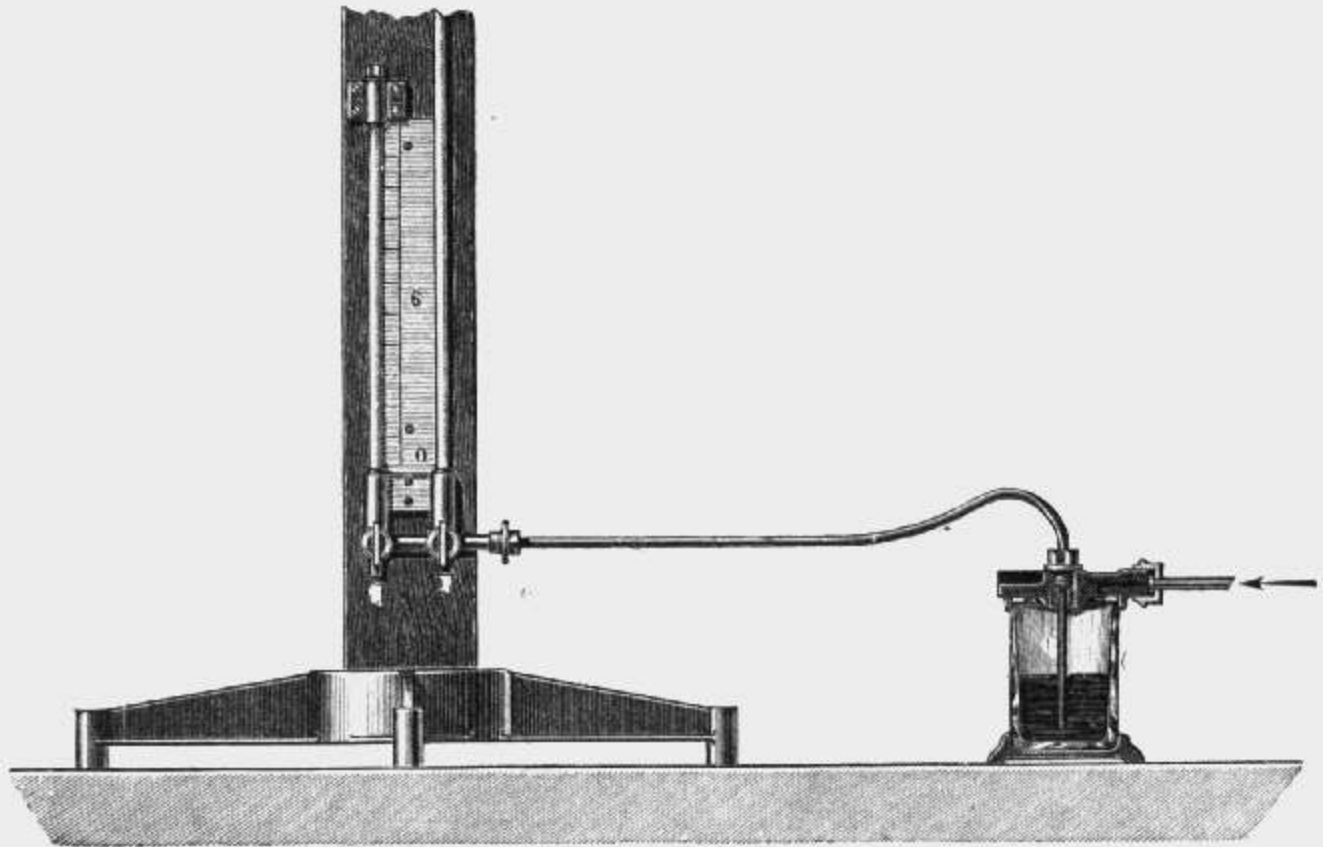
0600. <b>Large Analytical Scales</b> , mounted on a cast iron stand, which makes them independent of its glass case. Length of beam 55 centim., the knife edges are of steel and rest on agate bearings; sensitive to 0,2 milligr. with a maximum load of 1 kilogr. in each pan; index for estimating fractions of a milligr.; spirit level . . . . .	900
0605. <b>Analytical and Assay Scales</b> mounted in the same manner as the preceding one; beam 400 millim. long; sensitive to 0,5 milligr. with a maximum load of 500 grams in each pan; index, spirit level . . . . .	550
0610. <b>Assay Scales for Chemists</b> , length of beam 200 millim.; capacity 250 gr., sensitive to 0,5 milligr.; case with glass doors . . . . .	280

Nos	Francs.
0615. <b>Assay Scales for Chemists</b> , small size, length of beam 235 millim., capacity 200 gr., sensitive to 1 milligr.; glass case . . . . .	170
0620. <b>Small Roman or Pocket Scales</b> , especially for the use of physicians (see <i>Medicine</i> , § 69) . . . . .	50
0625. <b>Hydrostatic Scales</b> , large model mounted on a cast-iron tripod, capacity 1,5 kilogr. in each pan, sensitive to 10 milligr., beam 410 millim. long. Height of shelf regulated by a rack and pinion within the limits of 15 centim.; spirit level, two pairs of pans . . . . .	250
0630. <b>Do.</b> small model. — Cast-iron tripod; capacity 0,75 kilogr. in each pan; sensitive to 10 milligr. . . . .	180
0635. <b>Fessel and Plücker's gyroscopic Scales</b> . . . . .	100
0650. <b>A Standard Kilogram</b> in a box . . . . .	70
0655. <b>Box containing a 500 grams Standard Weight</b> , and 500 gr. in fractions; also the gram in fractions down to 1 milligr.; in platinum . . . . .	80
0660. <b>Box of 200 grams</b> in fractions as above . . . . .	75
0661. <b>Box of 100 grams</b> " " . . . . .	55
0662. <b>Box of 50 grams</b> " " . . . . .	50
0663. <b>Box of 20 grams</b> " " . . . . .	45
Weights heavier than one gram are made of golden or plated brass.	
0665. <b>Box containing only one Gram</b> and its fractions down to one milligr., in platinum, with ivory tipped piers . . . . .	30

### § 07. Manometers.

0700. **Mariotte's Apparatus** for pressures up to three atmospheres. — This apparatus is designed to let the mercury rise in the tubes, by compressing the air above the mercury contained in a special recipient. Thus a column of mercury is obtained free from air bubbles, and the operating is much

Nos	Francs.
more expeditious. If necessary the tube may be prolonged about 1 metre ( <i>fig.</i> ) . . . . .	200



0700.

- |       |  |     |
|-------|--|-----|
| 0705. | <b>Open Manometer</b> for the vacuum and pressures up to one atmosphere. Regnault's model with brass scale . . . . .   | 130 |
| 0710. | <b>Do.</b> for pressures up to two atmospheres . . . . .   | 180 |
| 0715. | <b>Do.</b> up to five atmospheres . . . . .  | 300 |
| 0720. | <b>Manometer for the Vacuum with Comparison Barometer.</b> The barometrical and manometrical tubes are fixed parallelly on a support and plunge into the same bowl. The manometrical tube is provided with another tube and a cock for connecting it with various apparatus. A millimetric scale placed behind these tubes indicates the degree of rarefaction. Tripod with three levelling screws . . . . . | 120 |
| 0725. | <b>Do.</b> of larger dimensions and mounting entirely metallic; tubes 11 millim. inside diam., reads to $\frac{1}{20}$ millim. . . . .   | 250 |
| 0730. | <b>Precision Manometer,</b> with complete barometrical column, for pressures approaching vacuum. The comparison  |     |

Nos

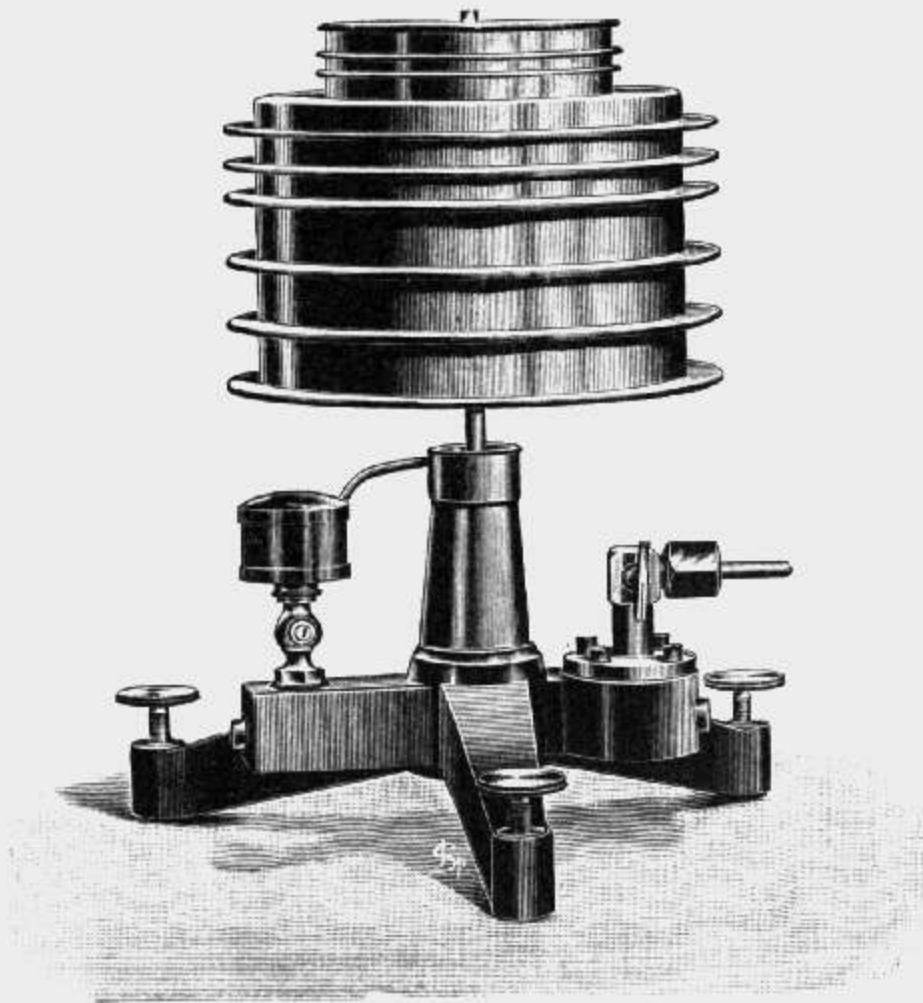
Francs.

barometer and the manometrical tube plunge into the same bowl. One needs then only to measure the difference of height between the two menisci. A small cathetometer permits the observation both of the manometer and of the barometer or the reading of the scale engraved on glass, which is placed at the focus of the telescope, between the two tubes. The diameter of the mercurial columns is about 15 millim., the scale reads to  $\frac{1}{25}$  millim . . . . .

700

0735. **Closed Manometer** for pressures up to nine atmospheres: lecture room model, crystal bowl, cast iron mounting . . .

45



0760.

0740. **Manometer**, model like preceding fitted with an open tube. This model enables students to compare the two sorts of manometers . . . . .

60

0745. **Small open Manometer** on a board, for pressures not exceeding 20 centim. . . . .

12



Nos	Francs.
0750. <b>Truncated Manometer</b> , can be placed under a pump receiver. . . . .	15
0755. <b>Do.</b> on a pedestal covered with a bell shaped glass tube and fitting to pneumatic pumps by means of a rubber or copper tube . . . . .	25
0760. <b>Marecx's manometer</b> ; the compressed gas or the liquid is connected, by a cock, with the bottom of a vertical cylinder filled with oil; the upper part of the cylinder is closed by a plunging piston laden with weights for counterpoising the pressure of the fluid. The section of the cylinder is so calculated that one kilogr. of the load corresponds to one atmosphere of pressure ( <i>fig.</i> ) . . . . .	350

### § OS. Pendulums.

0800. <b>Support with four single pendulums</b> of different lengths and substances, the longest beating seconds . . . .	30
0805. <b>Reverting pendulum</b> for the lecture-room with explanatory notice . . . . .	120
<p style="margin-left: 40px;">The apparatus made entirely of brass and steel permits of the complete verification of the laws of compound pendulums or of reverting pendulums. The length of the apparatus is such as to produce an oscillation in <math>\frac{3}{4}</math> of a second (<i>fig.</i>).</p>	
0810. <b>Kater's pendulum.</b> Revertible pendulum beating seconds. The time of the vibrations is measured by the method of coincidences: with case . . . . .	280
0815. <b>Bessel's reverting pendulum.</b>	

The time of a single vibration of the pendulum is about three quarters of a second. Heavy-headed screws concealed in the small cylinder at the end of each of the bobs serve to obtain, with all desirable accuracy, the equality of the vibrations of the reverted pendulum.

The knife-edges and bearing plane are of agate.

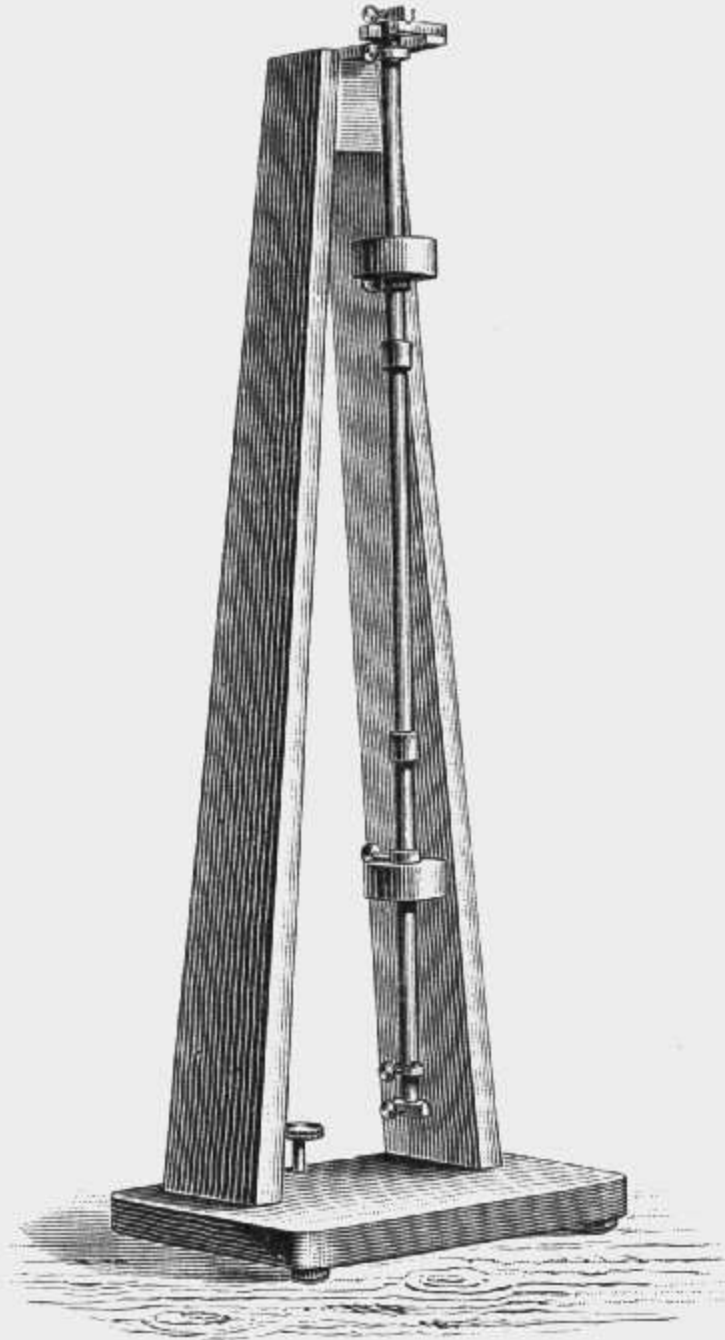
The error resulting from the vibratory motion of the bearing plane is much diminished by a solid construction of its supports.

Nos

Francs.

At the same time, the using four supports, instead of three, secures the rectilinear motion of the plane; this is required for using the formulae of correction based on the comparison of two pendulums of different weights.

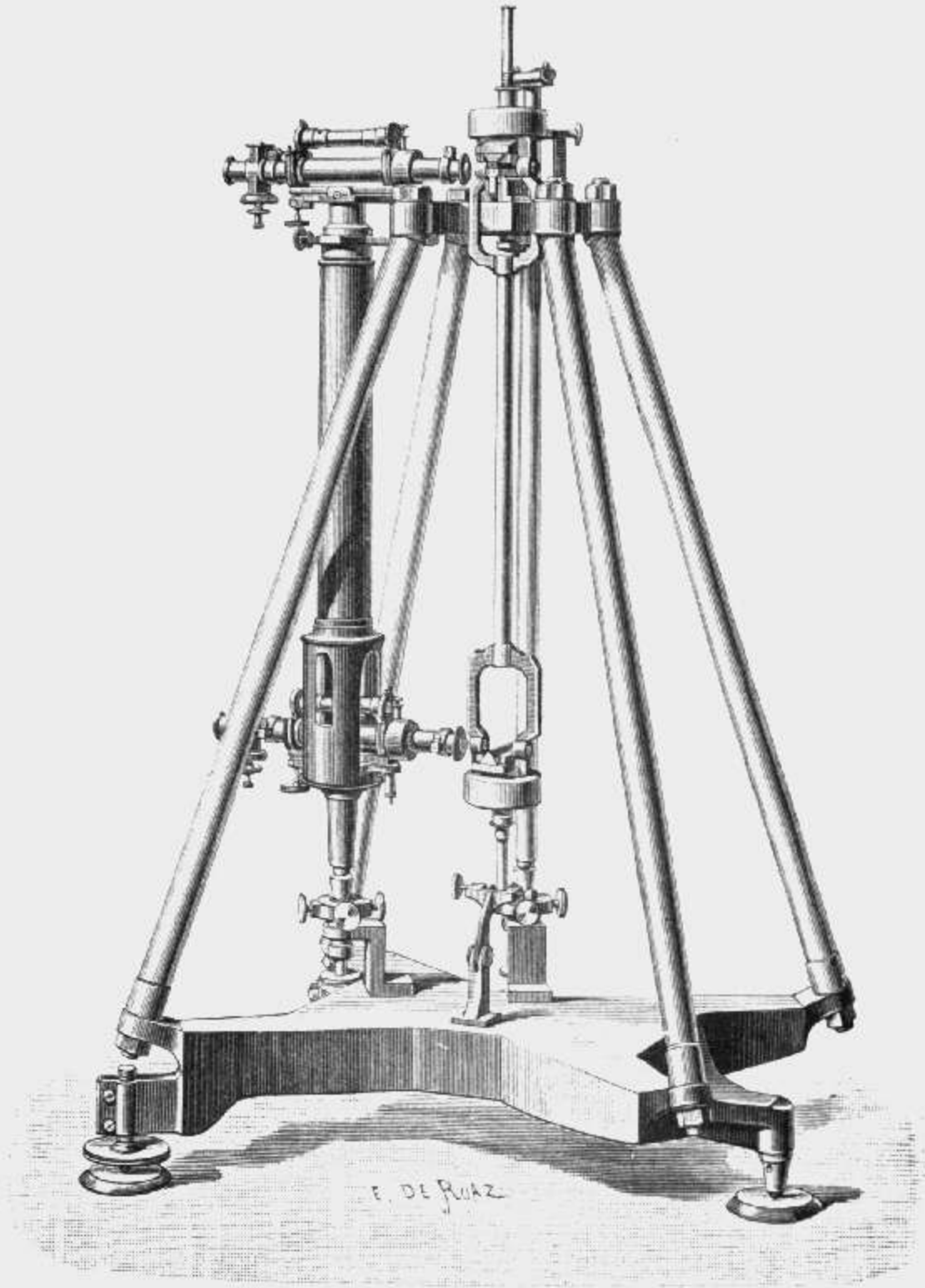
These two pendulums form part of the apparatus.



0805.

The cathetometer, with two telescopes and an independent scale fixed to the instrument for reading the distance between the two knife-edges is provided with all the means of adjustment necessary for the exactness of the measurements (*fig.*).

Price of the apparatus and cases . . . . . 2600



0815.

0820. **Borda's compound Pendulum** to determine the time of one vibration. Iron support fastened to the wall: agate bearings, levelling screws; spherical bronze bob 80 millim. in diameter. Without the clock . . . . . 275
0825. **Pendulums** for lectures or for clocks.  
Mercurial compensation pendulum.

Nos

Francs.

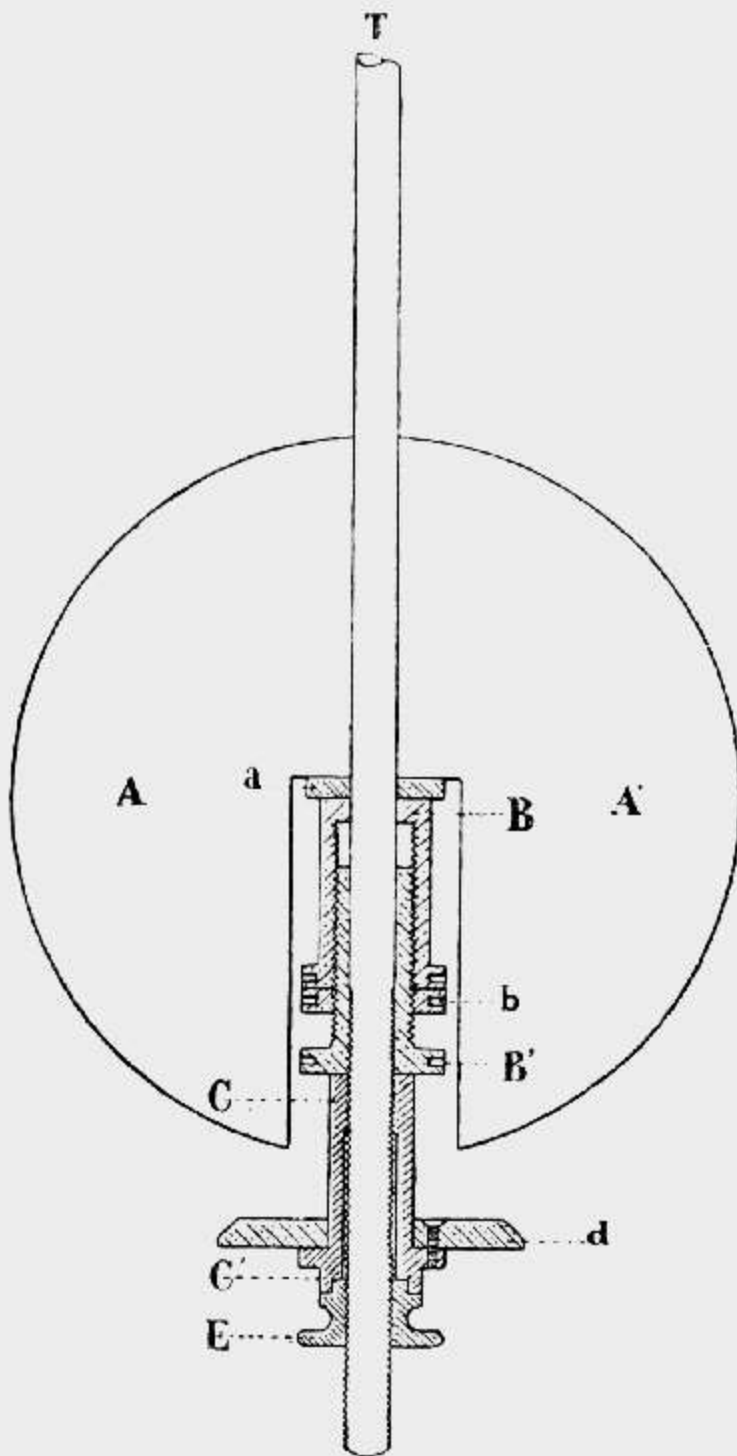
Leroy's pendulum.  
 Gridiron pendulum.  
 Deal and zinc compensation pendulum.

0830. **Pendulum beating seconds**, with visible escapement.

Electric contacts . . . . . 150

0835. **Standard Pendulum** of nickel-steel, Guillaume's alloy,  
 called *invar* (see n° 0130), with compensating tube of brass.

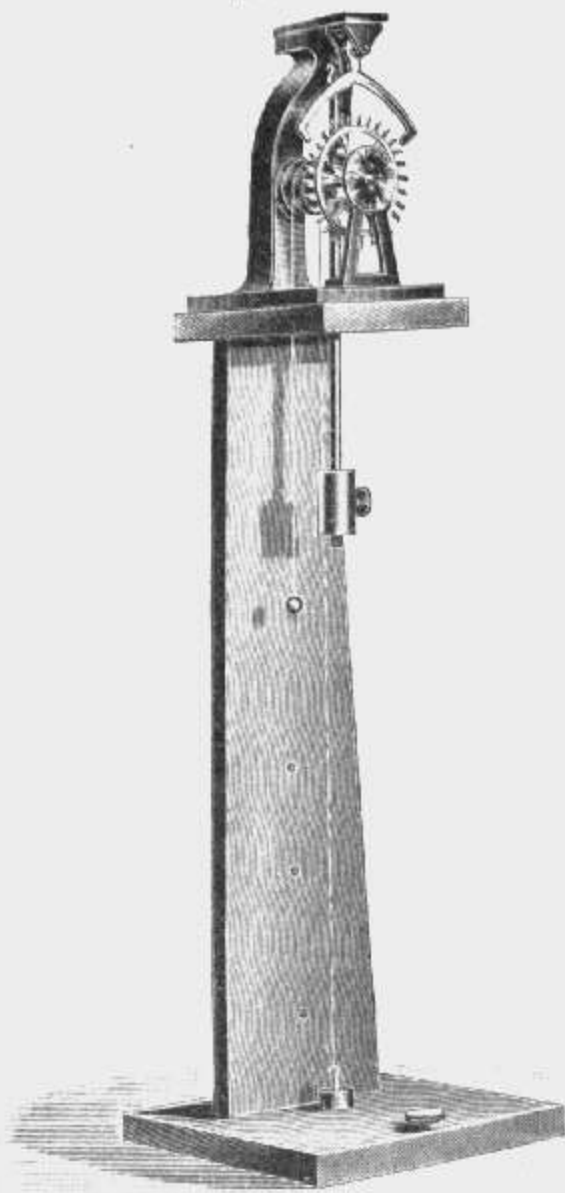
(fig.). . . . . 100 to 120



EXPLANATION

- T Cylindrical rod of the pendulum of *invar* alloy.
  - AA' Bob with a slit in the lower part. Cast iron, or preferably *invar* alloy.
  - a Ring of the same metal as the bob; its thickness regulates the position of the point of contact between the compensating tube and the bob, near the centre of oscillation of the system.
  - BB' Compensating tube of brass formed of two parts screwing into each other, which allows of regulating at will the total length of the compensating tube.
  - b Check-nut serving to fix invariably the length of the compensating tube. It is worked, as well as the two adjoining flanges, by introducing a steel point into the holes pierced in the circumference of the flanges and shown in the figure.
  - CC' Regulating nut of *invar* alloy threaded only in the upper part.
  - d Graduated disc of the nut, fixed on CC' by means of three screws. It can be of any metal, of brass for instance.
  - E Regulating check-nut, *invar* alloy.
- The thread of the regulating nut is  $\frac{1}{2}$  millimetre. The edge of the disc is divided into 50 parts, each corresponding to  $\frac{1}{500}$  millimetre.

Nos	Francs.
0840. <b>Graham's Anchor Escapement</b> , lecture-room model. Escapement wheel 10 centim. in diameter; pendulum beating seconds or half seconds ( <i>fig.</i> ) . . . . .	150



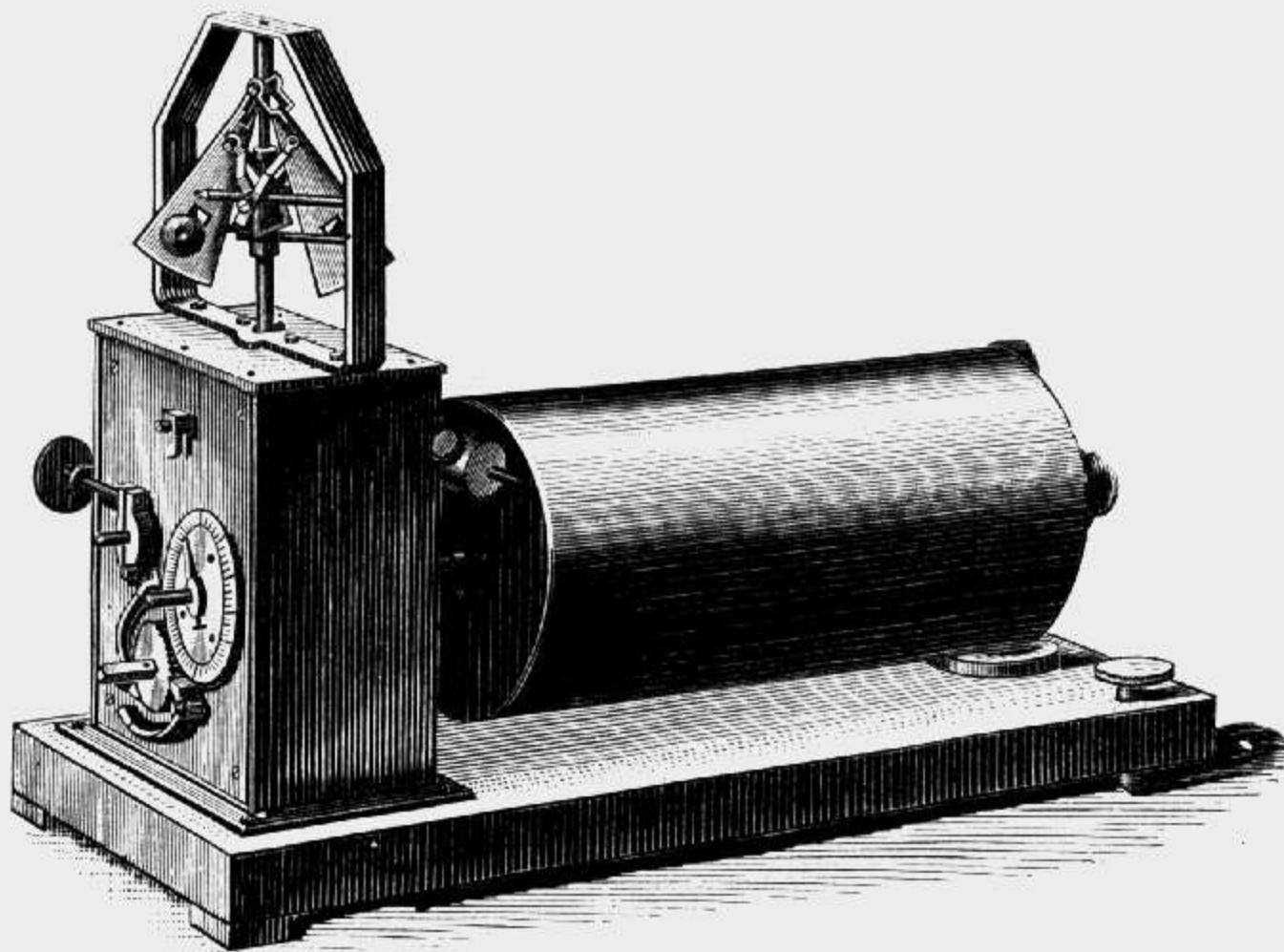
0840.

0845. <b>Lepaute's Peg Escapement</b> . Same dimensions as the preceding . . . . .	150
0850. <b>Model of Escapement</b> in wood of large dimensions. Cylinder, duplex anchor, mainspring. Each . . . . .	100

### § 09. Metronomes, Tuning Forks, Chronographs, Chronometers.

0900. <b>Metronome</b> . . . . .	20
0905. <b>Tuning Fork</b> $ut_1 = 1024$ single vibrations, mounted on its resounding chest . . . . .	35

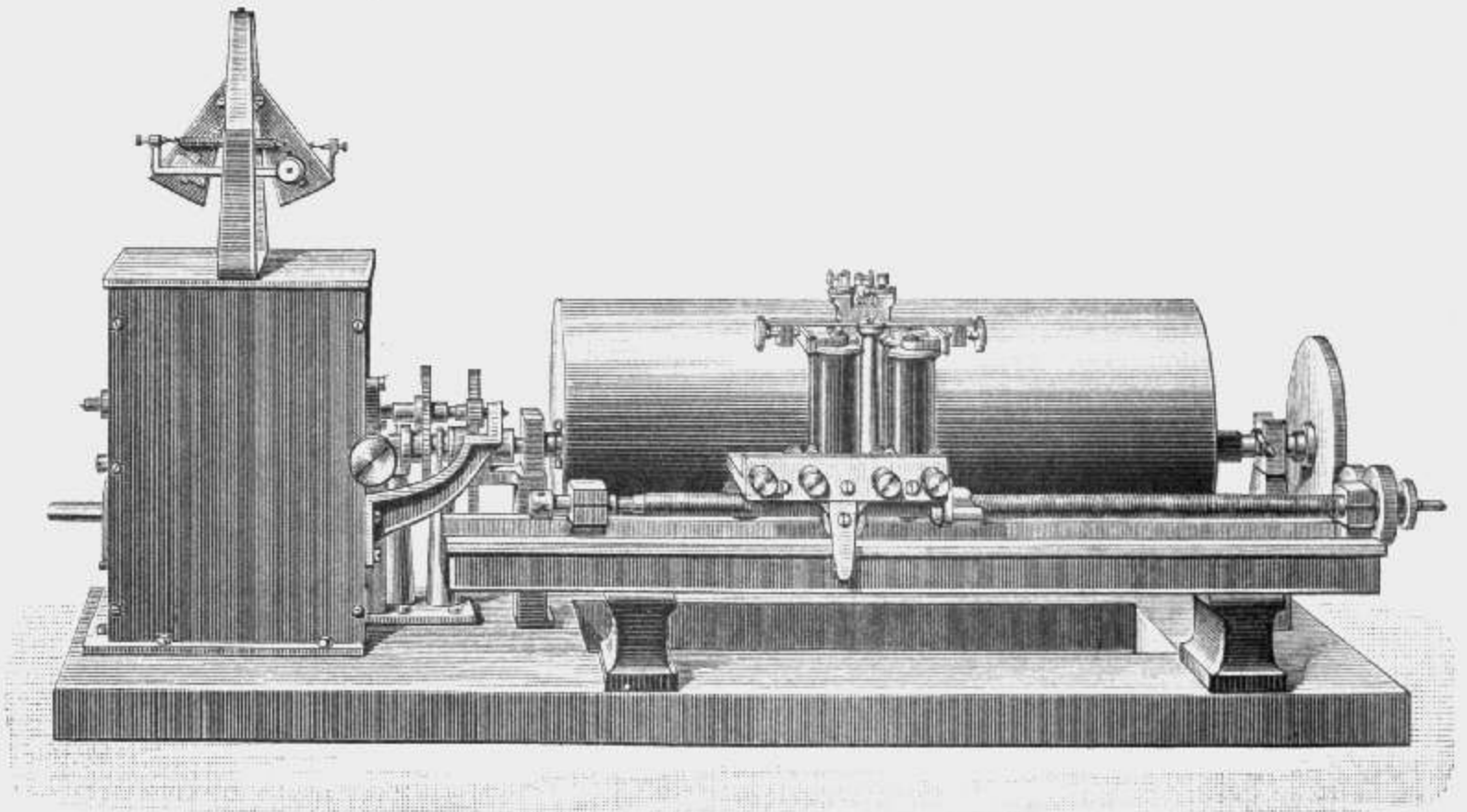
Nos				Francs.
0906.	<b>Do.</b>	ut <sub>3</sub> = 512 single vibr.	do. . . . .	40
0907.	<b>Do.</b>	ut <sub>2</sub> = 256 " "	do. . . . .	110
0908.	<b>Do.</b>	la <sub>3</sub> = 870 vibr. French official diapason . . . .		35
0910.	<b>Chronograph Diapason</b> , electrically supplied; used with registering apparatus.			
		of 100 single vibrations . . . . .		120
0911.	<b>Do.</b>	128	do. . . . .	120
0912.	<b>Do.</b>	200	do. . . . .	110
0913.	<b>Do.</b>	256	do. . . . .	110
0914.	<b>Do.</b>	500	do. . . . .	110
0915.	<b>Do.</b>	512	do. . . . .	110



0920.

0920.	<b>Clock-work Movement</b> with registering cylinder and Foucault's regulator; with three different rates of speed ( <i>fig.</i> ).	600
0921.	<b>Clock-work Movement</b> with regulator of plainer construction . . . . .	550

Nos		Francs.
0925.	<b>Marey's Lever registering Drum</b> . . . . .	50
0926.	<b>Do.</b> with a regulating screw . . . . .	70
0930.	<b>Chronograph</b> with Foucault's regulator. Screw-carriage with variable speed bearing two pens, which are run by electro-magnets. The speed of the cylinder can be easily changed. One turn of the cylinder every minute, every 10 seconds or every second ( <i>fig.</i> ) . . . . .	1250
0935.	<b>Do.</b> the same instrument for two different speeds. The cylinder revolves in 1 minute or in 10 seconds. . . . .	1200



0930.

0950. **Model of the Regulator** of marine chronometers, comprising balance, hair-spring and escapement; to serve for the demonstration of the laws of vibratory motion in chronometers. Balances of different weights and diameters. Hair-spring can be changed . . . . . 700
0955. **Precision Clock**, mounted in a case, going eight days: Graham's escapement and mercurial compensation pendulum. 650

# CHAPTER 1

## MATHEMATICS, GEODOSY, ASTRONOMY

- § 10. Graphic Drawing.
- 11. Land-surveying.
- 12. Levels.
- 13. Theodolites.
- 14. Meridian Telescopes.
- 15. Meridian Circles.
- 16. Equatorial Mountings.
- 17. Telescopes for Observatories.
- 18. Astronomical Spectrometers.
- 19. Astronomical Micrometers.

Nos

Francs.

### § 10. Graphic Drawing.

**Graduated Metres, Scales, Dividers, Protractors, etc.** (See *General measuring instruments*, chapter 0.)

1000.	<b>Ruler for drawing Curves</b> by interpolation. Ruler 55 centim. long, on which can be shifted lengthways 6 small supports, each being provided with a rod allowing of a shifting perpendicular to the ruler. The extremities of the rods form six interpolation points on which a flexible bar is fitted. Each rod bears a micrometer screw ; box for the apparatus . . .	110
1001.	<b>Do.</b> without micrometer screws . . . . .	70
1010.	<b>Brass Pantograph</b> with graduated rods 45 centim. long .	170
1020.	<b>Precision Pantograph.</b> Rods 62 centim. long . . . .	400
	<b>Planimeters.</b> (See <i>General measuring Instruments</i> , Chap. 0, § 04.)	
1050.	<b>Linkages.</b> (See <i>Technical Mechanics</i> , Chap. 8.)	

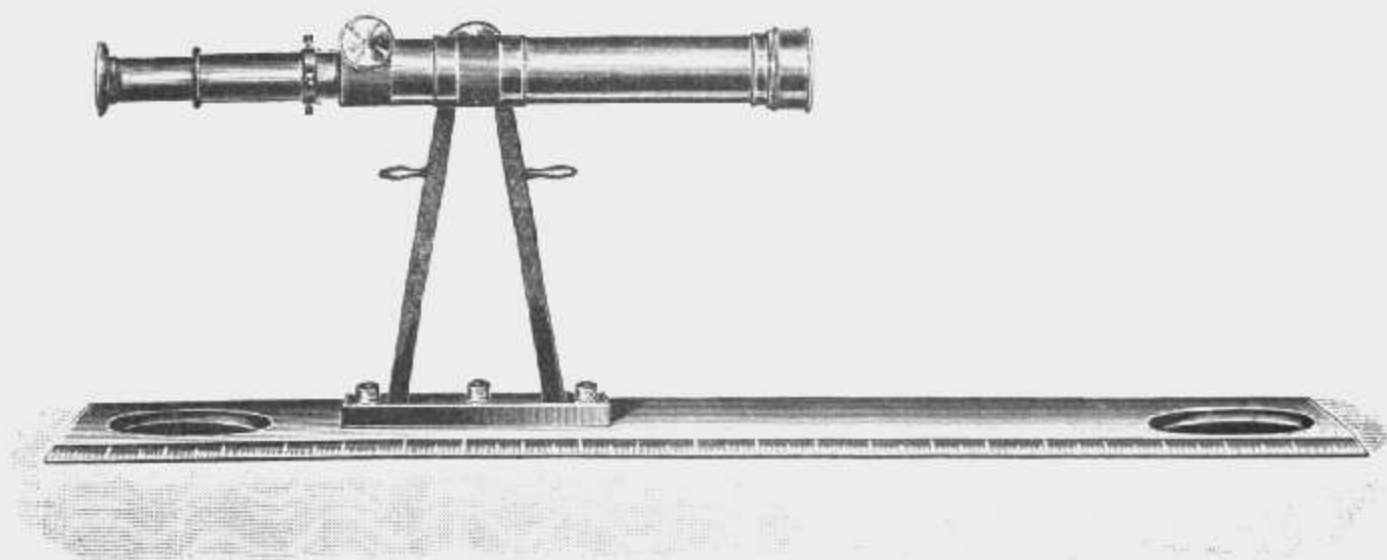


Nos

Francs.

### § 11. Land-Surveying.

1100.	<b>Plumb-line</b> , brass weight with steel point . . . . .	3 to 6
1105.	<b>Land-surveyor's Rule</b> , cylindric with slit and window, 65 millim. in diameter and 80 millim. high . . . . .	15
1110.	<b>Do.</b> with upper base slit to be used in moun- tainous districts, 75 millim. in diameter and 90 millim. high . . . . .	25
1115.	<b>Pantometer with rack and pinion</b> , 75 millim. in diameter, and vernier reading to two minutes . . . . .	50
1120.	<b>Telescope Alidade</b> , 25 millim. aperture, Reverting. Rule 55 centim. long, graduated on the bevel ( <i>fig.</i> ) . . . . .	115

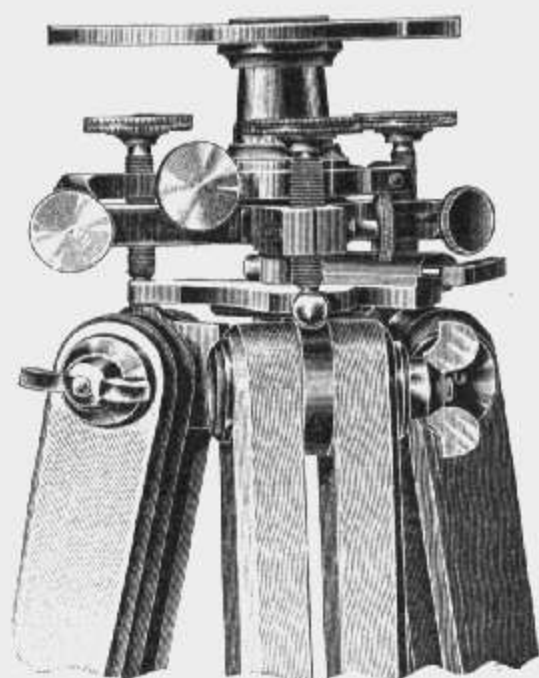


1120.

1125.	<b>Do.</b> with vertical circle arc, vernier reading to one minute . . . . .	135
1130.	<b>Ocular rectifying</b> the images, instead of the astronomic ocular . . . . .	10
1135.	<b>Compass known as declinatory</b> , used with the plane- table; graduated into half degrees, needle 125 millim. long; brass box . . . . .	35
1150.	<b>Tripod with single Legs</b> for pantometers . . . . .	14
1155.	<b>Tripod with double Legs</b> for telescope level . . . . .	30
1160.	<b>Plane-table, Amsler's Model</b> , strongly constructed, 60×70 centim. ( <i>fig.</i> ) . . . . .	155

Nos

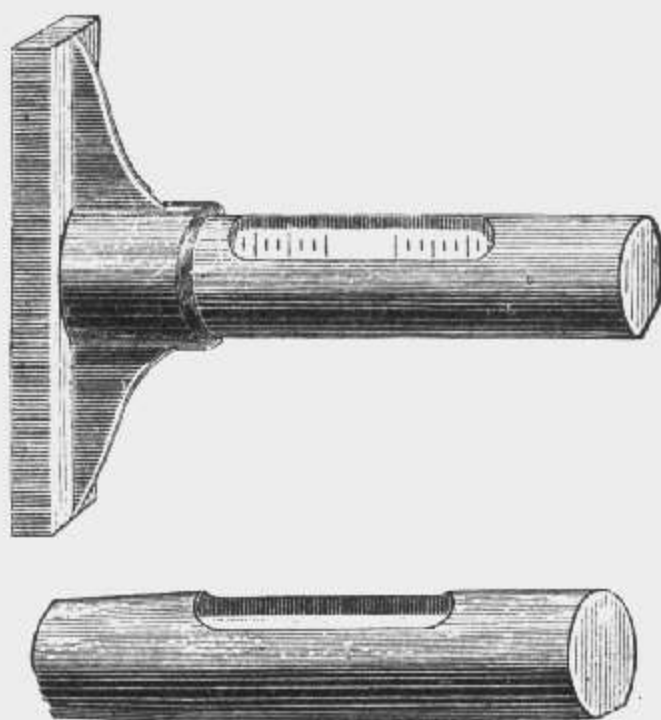
Francs.



1160.

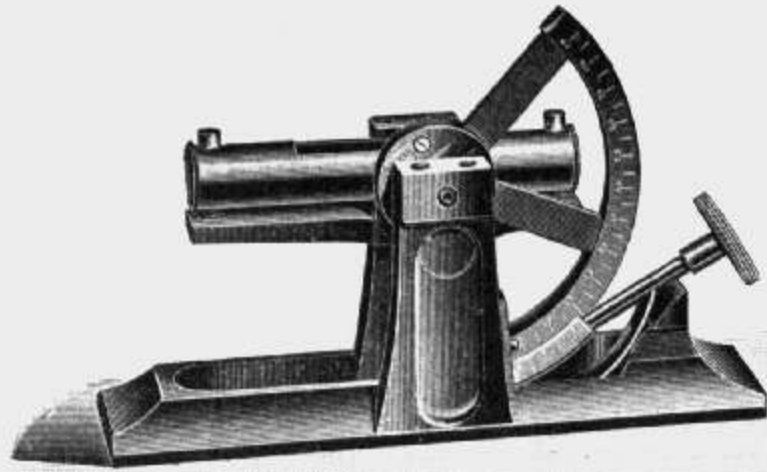
§ 12. Levels.

1200.	<b>Round Level</b> 50 millim. in diameter. . . . .	9
1205.	<b>Do.</b> 70 millim. in diameter . . . . .	12
1210.	<b>Long spirit Level</b> , adjustable . . . . .	16
1220.	<b>Do.</b> steel mounting, to work horizontally or vertically ( <i>fig.</i> ). . . . .	10
1230.	<b>Long Level</b> , mounted on a horizontal axis with graduated arc,	



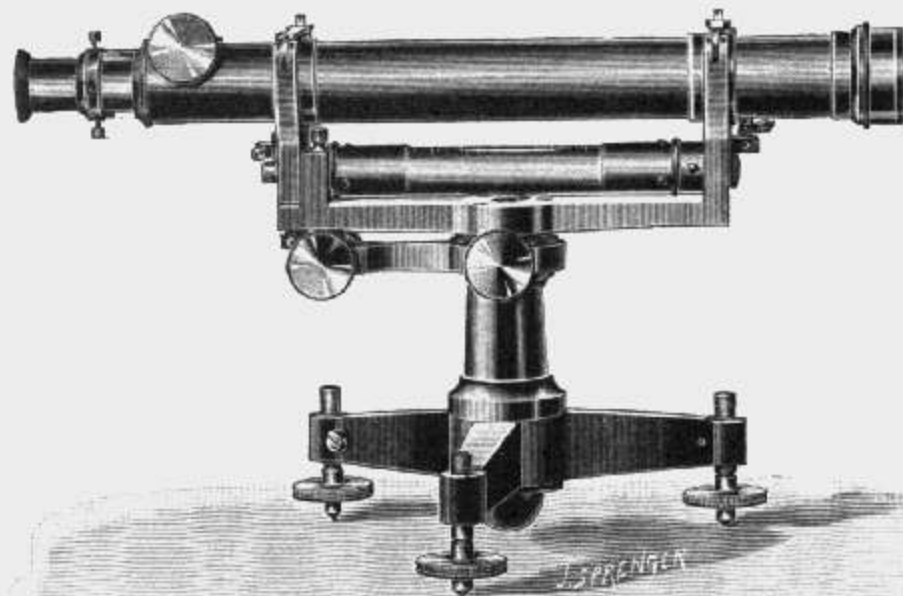
1220.

Nos		Francs.
	showing minutes ( <i>fig.</i> ). Regulating screw. The instrument is intended for the exact measurement of the slope of inclined planes	45



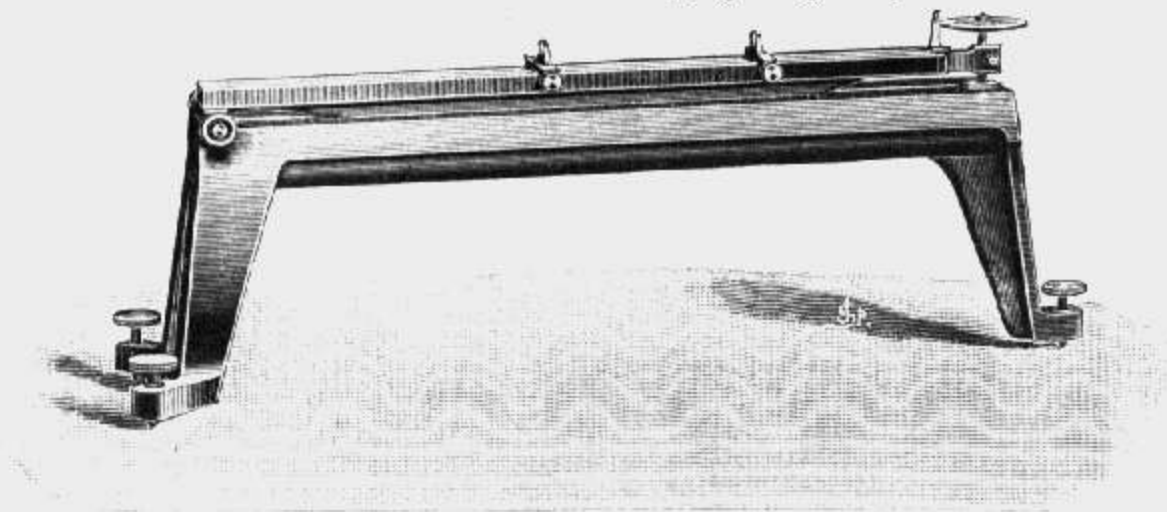
1230.

1240.	<b>Long spirit Level</b> for the plane-table, with brass mounting, base 24 centim. long, reading to 30" . . . . .	20
1250.	<b>Telescope Level</b> , known as <b>Egault's level</b> . The telescope can turn on its longitudinal axis and rest both ways on its sockets. Tightening press with regulating screw. Object-glass 27 millim. aperture; tripod with double legs ( <i>fig.</i> ) . . . . .	200
1251.	<b>Do.</b> with object-glass 33 millim. aperture . . . . .	250
1252.	<b>Do.</b> with object-glass 40 millim. aperture . . . . .	300
1255.	<b>Adjunction</b> of a horizontal circle indicating minutes with a vernier . . . . .	50



1250.

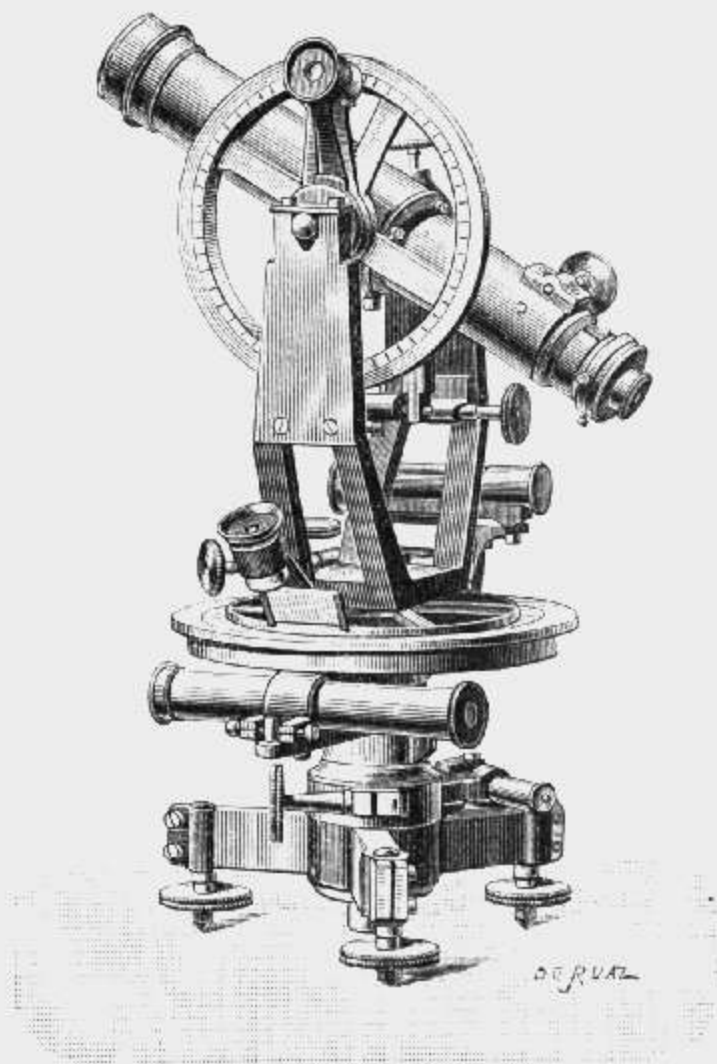
Nos		Francs.
1260.	<b>Apparatus for testing spirit Levels.</b> Cast iron stand 1 metre long. Micrometric screw indicating half seconds ( <i>fig.</i> )	160
1265.	<b>Do.</b> 60 centim. long, giving only seconds . .	130



1260.

§ 13. Theodolites.

1300. **Tacheometer** with horizontal circle 150 millim. in diameter, divided on silver, with vernier reading to  $\frac{1}{50}$  of a grade :

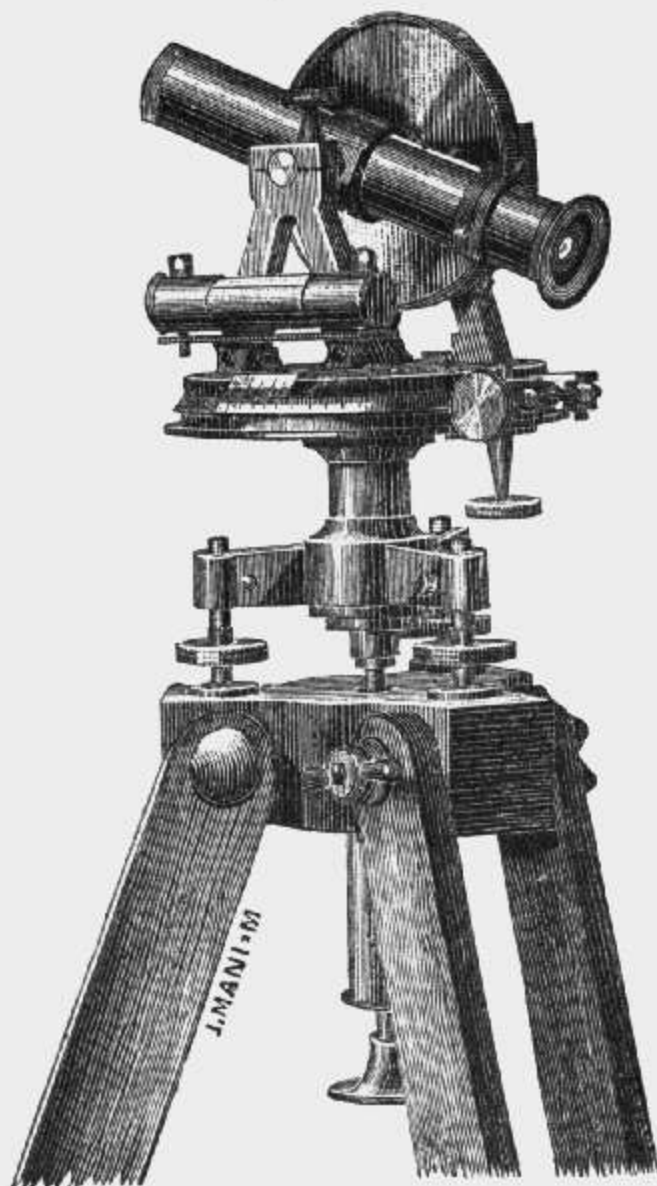


1300.

Nos

Francs.

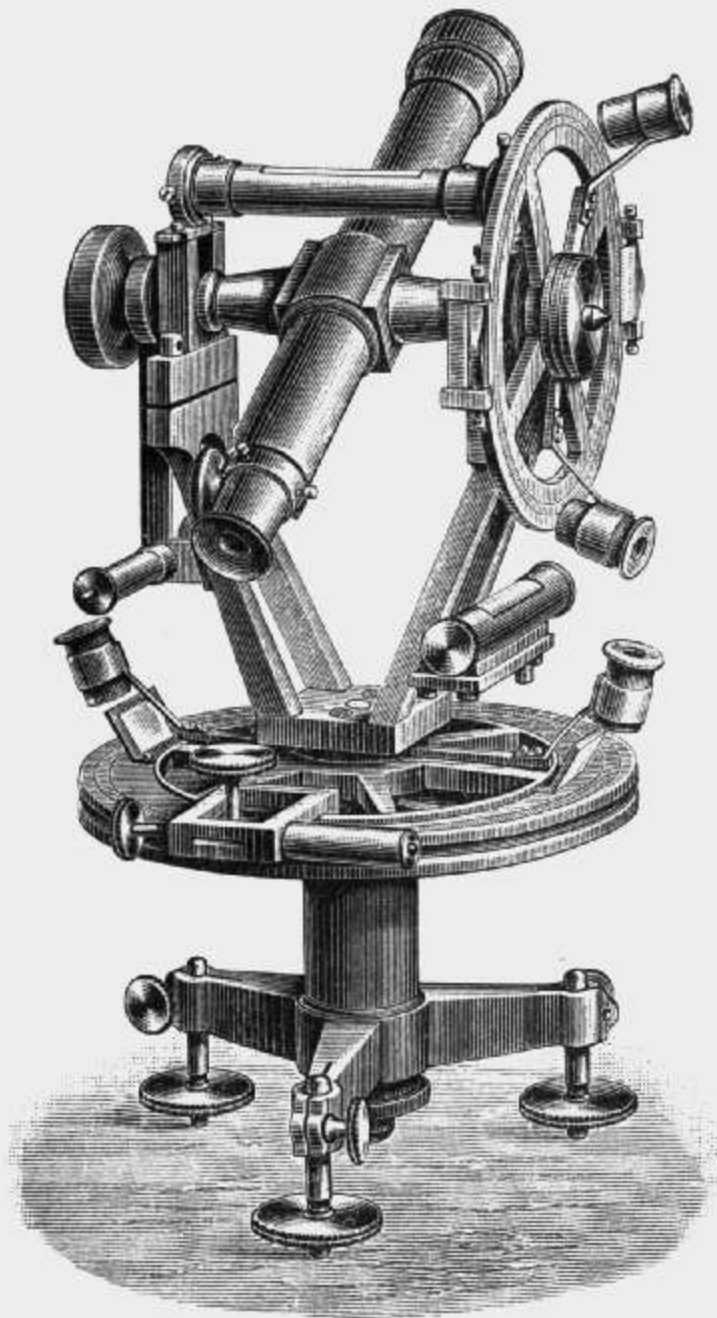
same scale for the vertical circle. Anallatic telescope 33 millim. aperture with micrometer having 5 divisions on glass and acting as stadia to the 50<sup>th</sup> or the 100<sup>th</sup> with an approximation of  $\frac{1}{300}$  of the distance. (*fig.*) . . . . . 500



1305.

1305. **Small portable Theodolite**, for excursions and tours. Horizontal circle 90 millim. in diameter, vertical circle 70 millim. in diameter (*fig.*) . . . . . 300
1310. **Theodolite without repeating Circle**, diameter of the circle 120 millim., aperture of the object-glass 22 millim., verniers reading to one minute, no vertical circle . . . . . 300
1311. **Do.** with vertical circle 140 millim. in diameter and verniers reading to one minute . . . . . 340
1315. **Do.** diameter of the circle 160 millim., aperture of the object-glass 27 millim., verniers reading to 30", no vertical circle . . . . . 375

Nos		Francs.
1316.	<b>Theodolite without repeating Circle,</b> with vertical circle 120 millim. in diameter . . . . .	430
1320.	<b>Theodolite, with repeating Circle,</b> diameter of horizontal circle, 160 millim. . . . .	440
1325.	<b>Do.</b> with vertical circle 120 millim. in diameter and verniers reading to one minute ( <i>fig.</i> ). . . . .	500



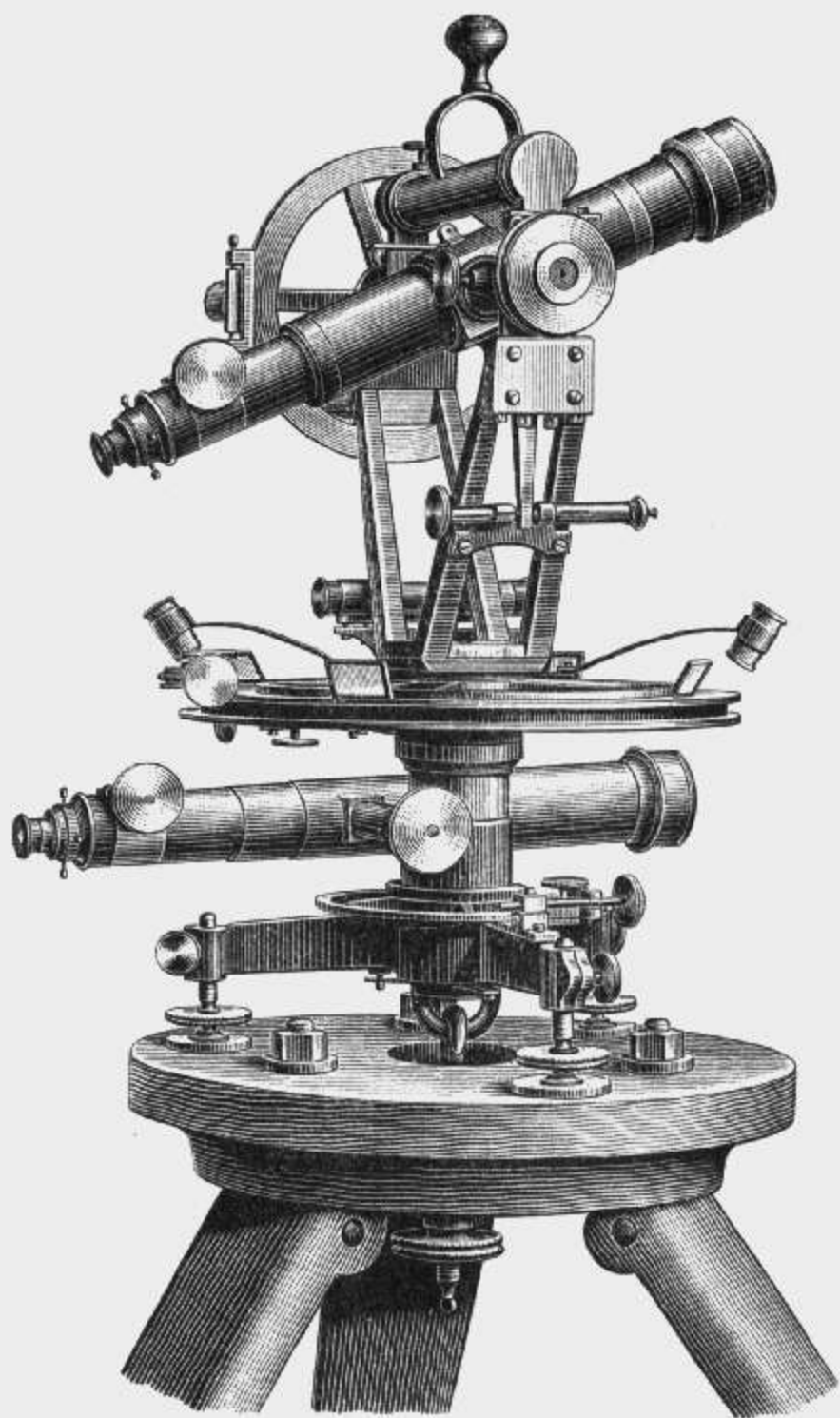
1325.

1326.	<b>Adjunction of a Level,</b> which can be placed on the telescope . . . . .	25
1330.	<b>Theodolite, with repeating Circle.</b> Diameter of azimuthal circle 210 millim., with verniers reading to 20"; vertical circle 140 millim. diameter, with verniers indicating minutes. Object-glass 33 millim. aperture, reference sight . . . . .	900

Nos

Francs.

1335. **Theodolite with repeating Circle.** Diameter of azimuthal circle 270 millim. with vernier reading to 10"; the ver-



1335.

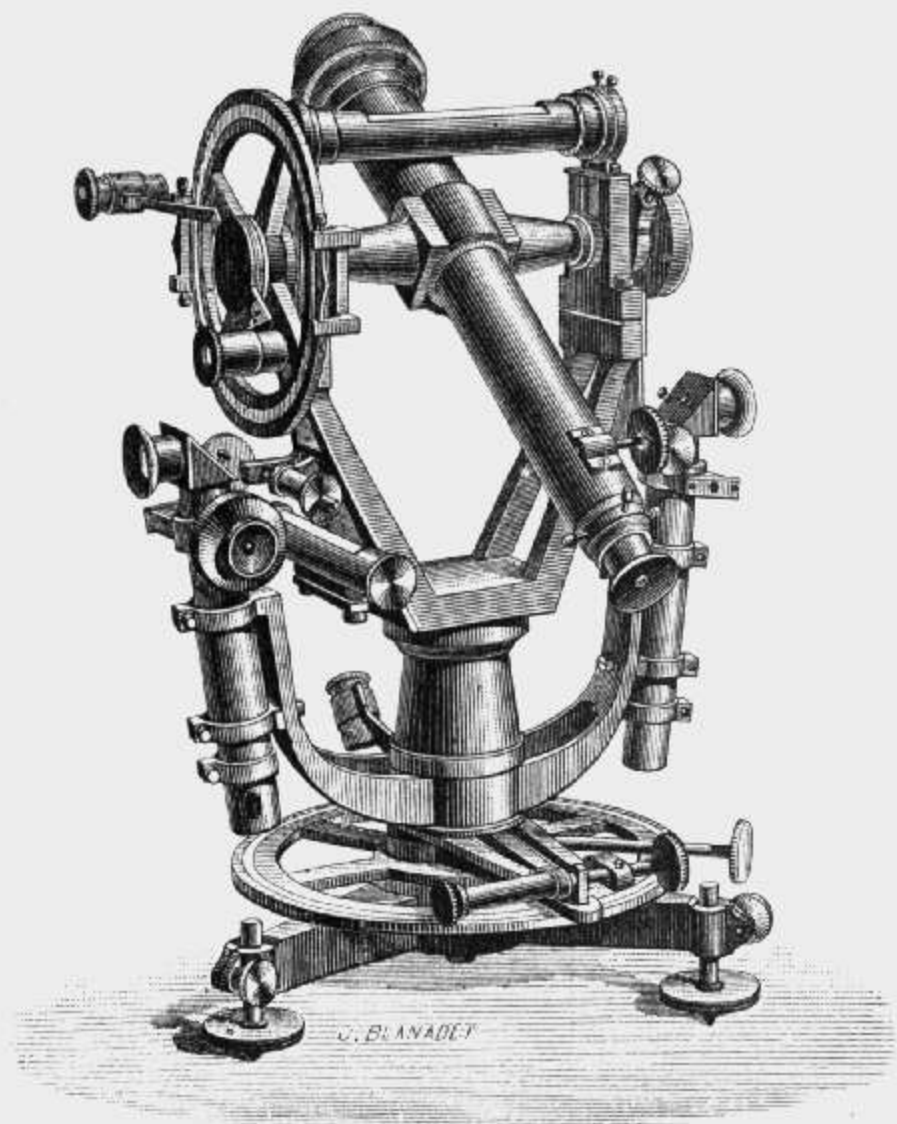
tical circle 160 millim. in diameter, with vernier reading to 30".  
Object-glass 40 millim. aperture, reference sight (*fig.*) . . . 1200

1340. **Azimuthal theodolite.** The azimuthal circle 160 millim. in diameter is repeating. The reading of this circle is made to 4" by means of two micrometer microscopes. Circle of support reading to 1 minute. Vertical circle 120 millim. in diameter with two verniers indicating minutes (*fig.*) . . . 1000

Nos

Francs.

1345. **Azimuthal Theodolite.** The azimuthal circle is repeating. The reading of the azimuthal circle is made by two micrometer microscopes; the telescope in the centre of the horizontal axis. Reference sight. Instrument balanced on all sides, the vertical axis supported. Azimuthal circle 270 millim. in diameter, vertical circle 180 millim. in diameter, reading to 30" by means of verniers. Object-glass 40 millim. aperture . . . 2400



1340.

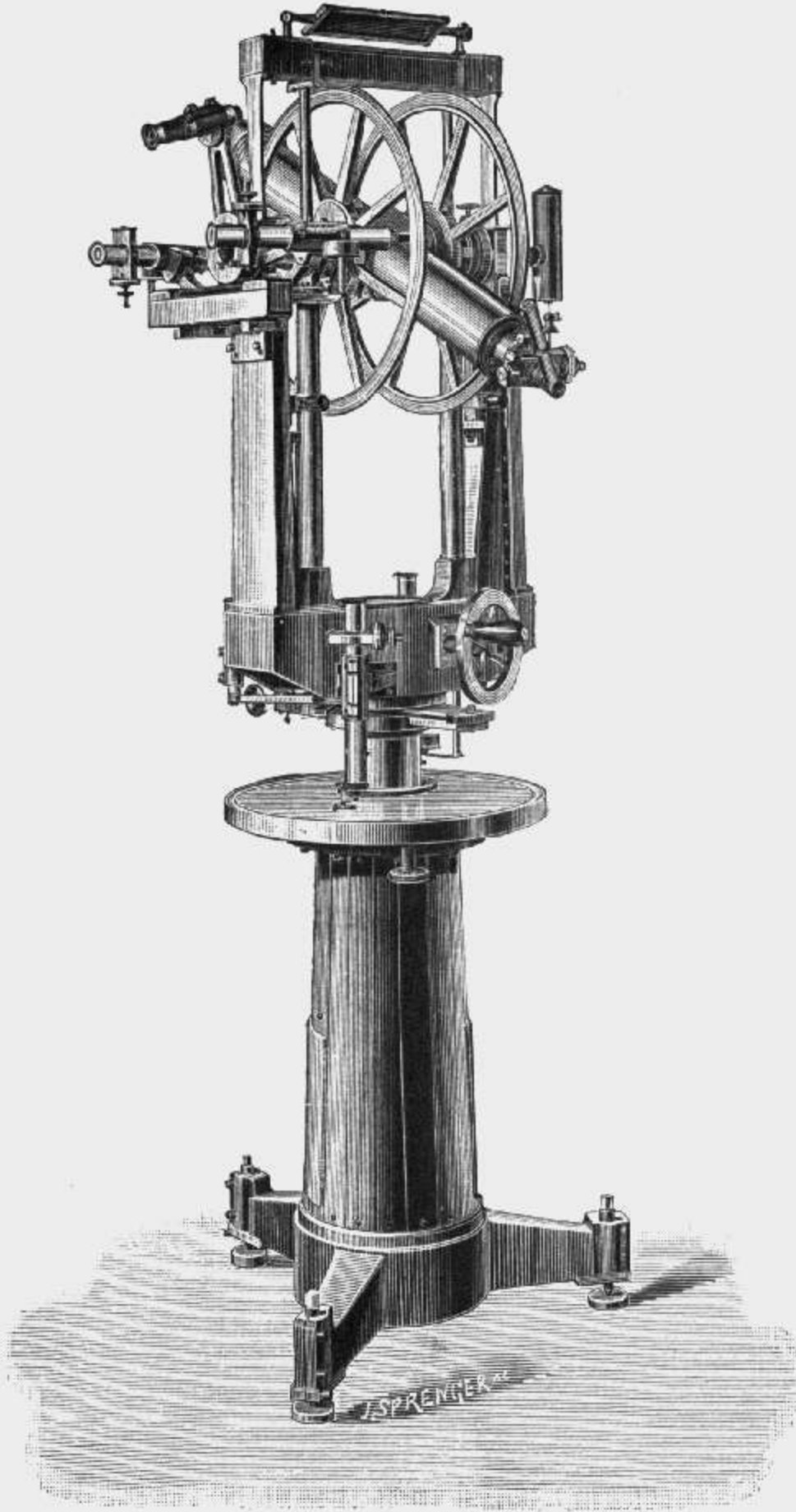
1350. **Altazimuthal Theodolite.** The two circles 240 millim. outside diameter are repeating, and read to 10 seconds; the vertical circle by four verniers, the horizontal one by two. The observing telescope 36 millim. aperture is fixed on the alidade of the vertical circle. Reference sight; threads illuminated; three eye-pieces, one with a prism . . . 2000



Nos

Francs.

1355. **Altazimuthal Theodolite.** Same construction as that of instrument n<sup>o</sup> 1340, but the reading of the vertical circle

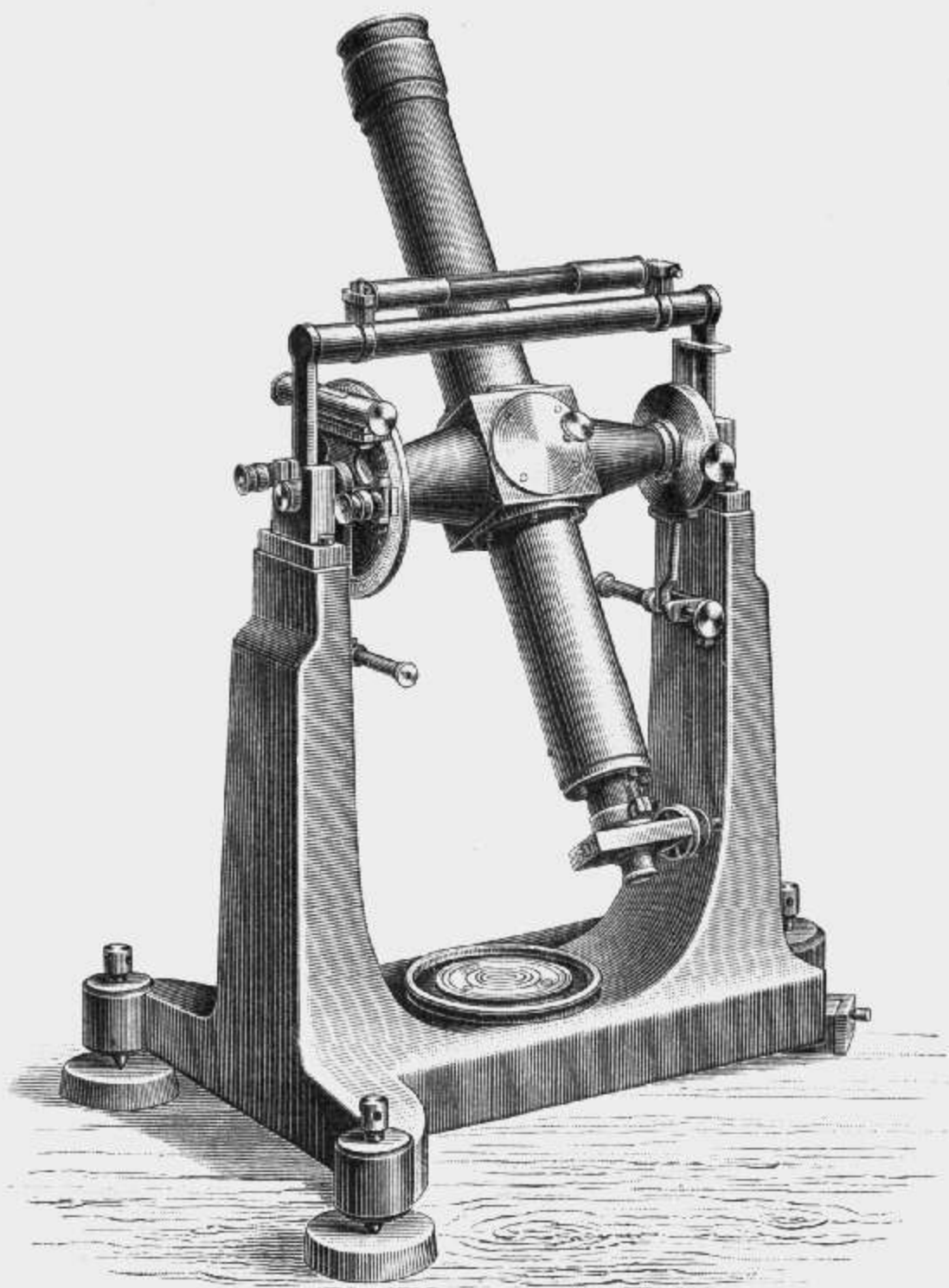


1360.

Nos		Francs.
	is made by two micrometer microscopes. Azimuthal circle 400 millim. in diameter, vertical circle 300 millim. in diameter. Object-glass 48 millim. aperture . . . . .	4000
1360.	<b>Altazimuth.</b> Instrument for standing on the ground. Repeating circles 40 centim. in diameter, two micrometer microscopes indicating seconds help to read each circle. Object-glass 68 millim. aperture. Clamping circles with verniers reading to 1 minute. The horizontal axis bears the telescope in the centre. Strong vertical axis 60 centim. long. Micrometer with several threads and three eye-pieces. Mechanical reverting movement forming an integral part of the instrument, which is well balanced on all sides. Special arrangement for lighting up the divisions of the levels and circles ( <i>fig.</i> ). . . .	5000

§ 14. Meridian telescopes.

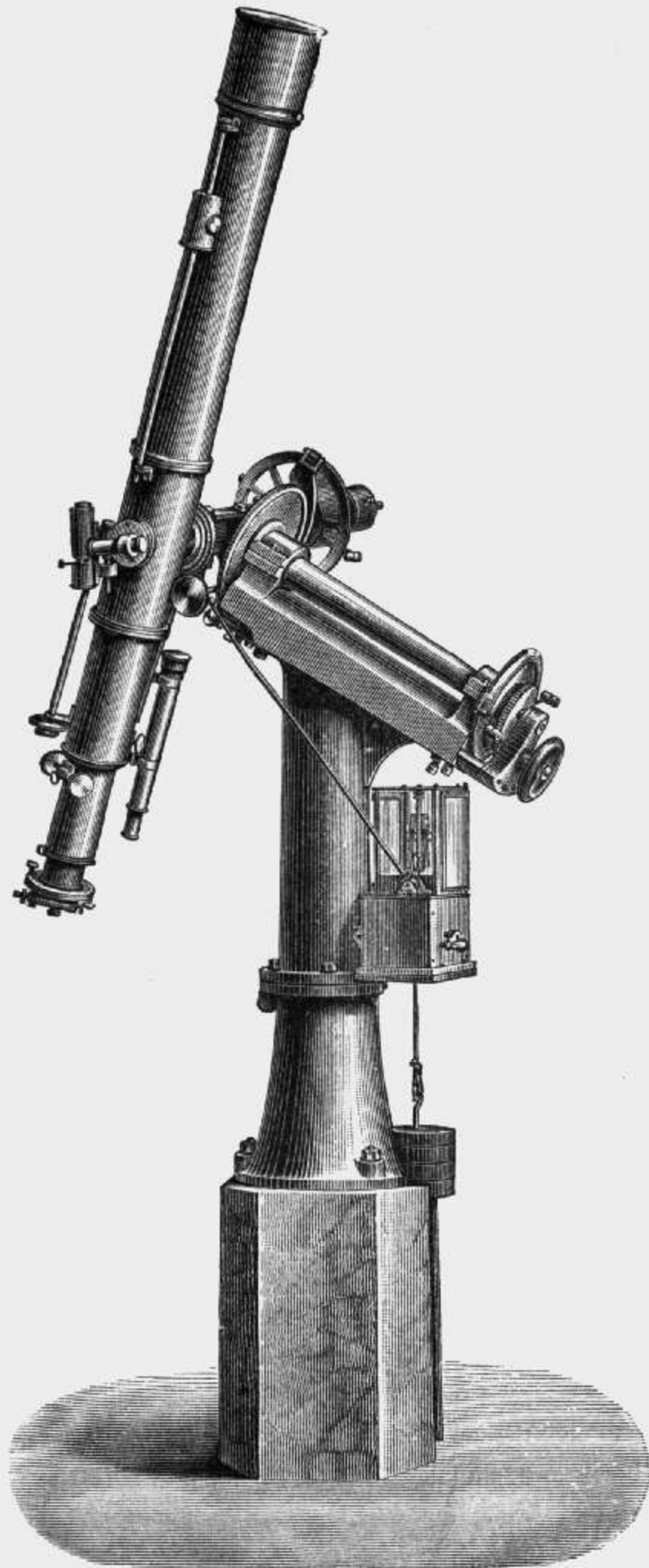
1400.	<b>Meridian transit Telescope.</b> Object-glass 40 millim. aperture ; hand reverting movement . . . . .	450
1410.	<b>Do.</b> Object-glass 47 millim. aperture . . . . .	600
1415.	<b>Do.</b> Object-glass 54 millim. aperture . . . . .	700
1420.	<b>Do.</b> Object-glass 60 millim. aperture. The two sockets are adjusted on two hollow cast iron uprights, forming but one piece provided with the necessary adjustments. Coarse micrometric movement of the telescope. Clamping circle fixed to the axis. Aperture in the axis and prisms for throwing light. Mechanical reverting movement ( <i>fig.</i> ). . . .	1400
1430.	<b>Do.</b> Same construction. Object-glass 67 millim. aperture . . . . .	1800
1440.	<b>Do.</b> Same construction. Well balanced axis. Object-glass 81 millim. aperture. Mechanical reverting movement . . . . .	2400
1450.	<b>Do.</b> Same construction. The sockets may be fixed on two stone pillars. Object-glass 95 millim. aperture . . . . .	3200



1420.

### § 15. Meridian circles.

1500. **Meridian Circle.** Object-glass 67 millim. aperture. The sockets are fixed on two hollow uprights forming a single cast iron piece provided with the necessary adjustments. The instrument bears on each side of the axis a circle 38 centim. in diameter. One of these circles is repeating and bears two silver scales, the other circle counterbalances the former and



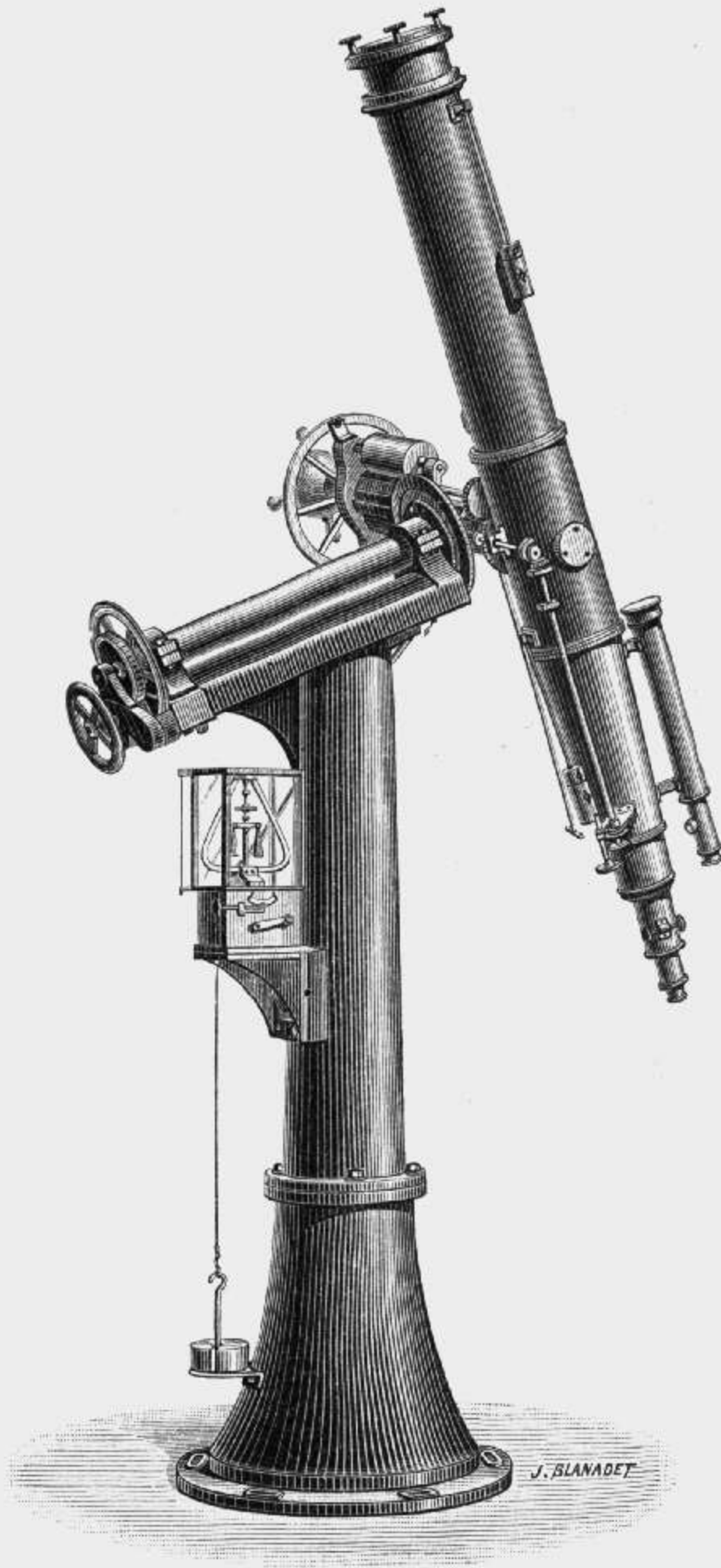
1600.

Nos		Francs.
	bears the regulating screws. The fine divisions are read to one second by means of two micrometer microscopes; the coarse divisions on the clamping circle are read by a small telescope. The axis and the microscopes are provided with a very sensitive level. The axis has tempered steel pivots and contains two holes inside of which are two small total reflection prisms for throwing light on the threads. Micrometer with three eyepieces, one with three glasses and a prism to observe the nadir. The instrument is carefully balanced. Mechanical reverting movement . . . . .	4000
1510.	<b>Meridian Circle.</b> Object-glass 81 millim. in diameter. Same construction as above . . . . .	6000
1520.	<b>Do.</b> Object-glass 95 millim. aperture. Same construction as above, or with the sockets fixed on stone pillars. The divisions are read by means of four micrometer microscopes. The instrument combines, besides, all the advantages of the preceding instruments. Circles 60 centim. in diameter . . . . .	7500

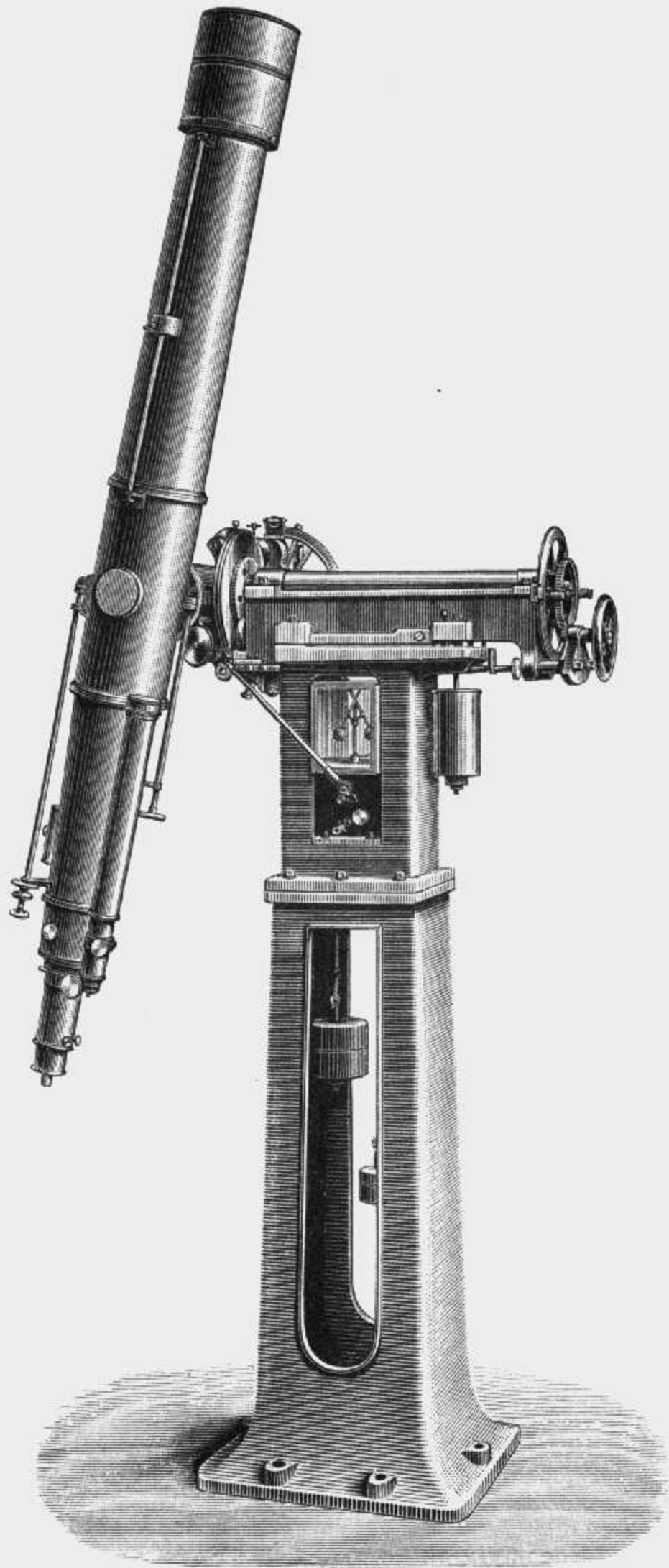
### § 16. Equatorial mountings.

(Without object-glasses.)

1600.	<b>Equatorial mounting</b> for a 4 inch object-glass with clock-work and isochronous regulator. Horal circle 20 centim., circle of declination 30 centim. in diameter, both divided on silver ( <i>fig.</i> ) . . . . .	4500
1610.	<b>Do.</b> for a 5 inch object-glass. Clock-work. The coarse adjustment of the horal axis is effected without interfering with the tangent screw. Regulating screws on the tube for the declination and the horal circles; regulating counter screws near the graduated circles. Circle of declination and horal circle 30 centim. in diameter. Position micrometer with black and shining threads. Searcher with a 54 millim. aperture . . . . .	7000
1620.	<b>Do.</b> like the above instrument, for a 6 inch object-glass. Horal circle 30 centim., circle of declination	



1620 a.

1620 *b.*

Nos	Francs.
40 centim. in diameter. Aperture of the searcher 64 millim. (fig. a and b) . . . . .	8500
1630. <b>Equatorial mounting</b> for a 7 inch object-glass . . .	12000

**§ 17. Telescopes for Observatories.**

1700. **Telescopes.**

The *Société Genevoise* undertakes the construction of astronomical instruments of large dimensions. It reserves treating with purchasers for the price, which necessarily varies according to the use for which the instrument is intended and according to the number of accessories required.

**§ 18. Astronomical spectroscopes.**

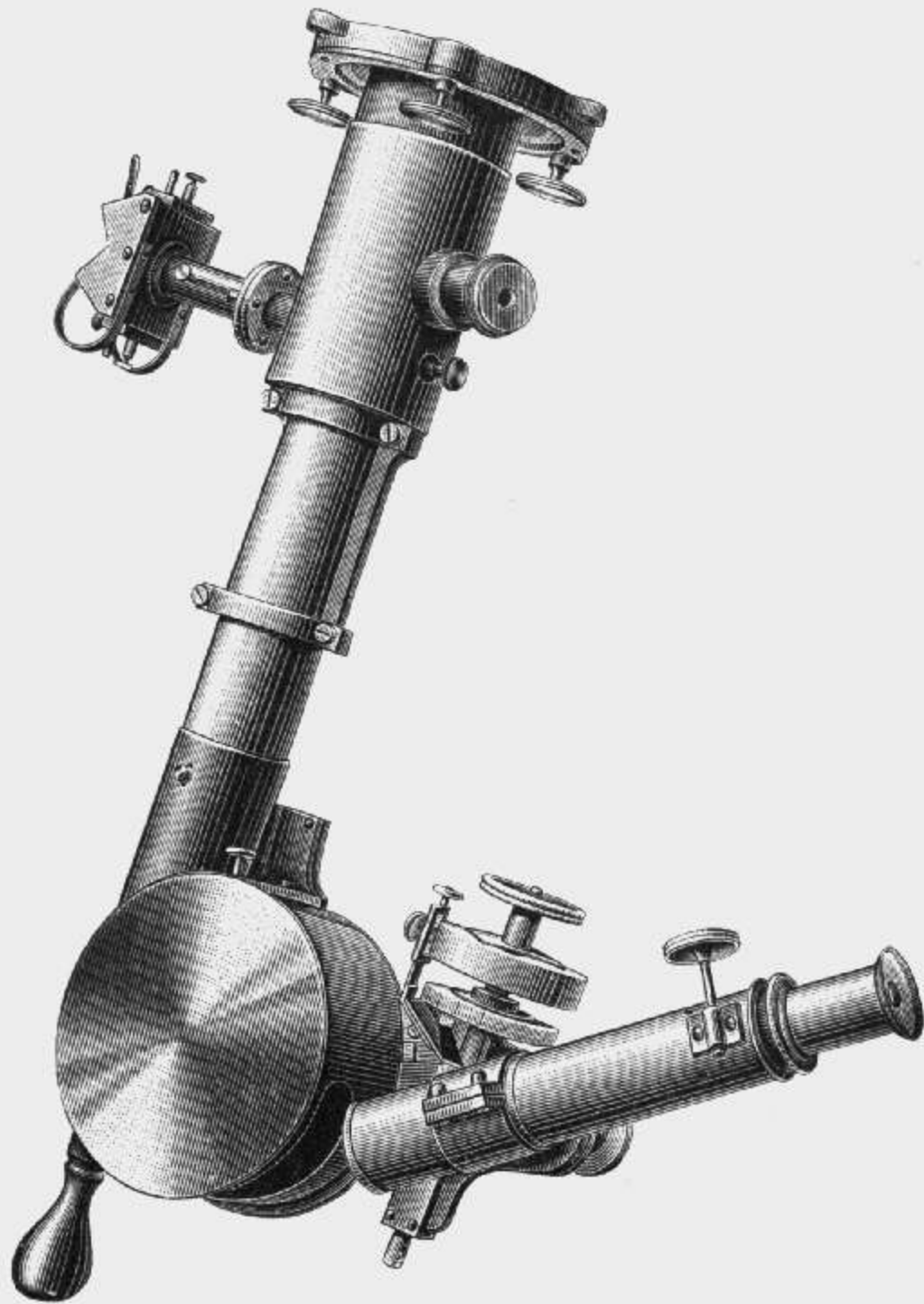
1800. <b>Direct vision and variable slit Spectroscope,</b> adapting to astronomical telescopes for the observation of the solar spectrum. . . . .	225
1810. <b>Astronomical Spectroscope.</b> Telescope 24 millim. aperture and 142 millim. focal distance ; two prisms 38 millim., cylindrical lens ; comparison prism, similar to fig. 1820 . . .	500
1820. <b>Do.</b> Telescope 27 millim. aperture and 192 millim. focal distance ; two prisms of 48 millim., cylin- drical lens, apparatus to receive Geissler's tubes or any kind of electrodes. Contrivance for easily removing one of the prisms or adding a direct vision prism in front of the telescope. Measurements are taken by means of a screw with a drum head divided on silver ; a second drum serves to record the observations taken in the dark by means of a metallic point, marking on a card. Three oculars (fig.) . . . . .	850
1830. <b>Adjunction</b> of a prism for direct vision . . . . .	100
1840. <b>Spectroscope for observing the Spectrum of Planets, Stars and the Sun.</b> This spectroscope con-	



Nos

Francs.

tains a variable slit collimator, a cylindrical lens and a comparison prism; the telescope, 24 millim. aperture, bears a micrometer with two threads, one movable by means of a micrometer screw with graduated drum head, the other also adjustable so as to coincide with a line of the spectrum. The instrument bears, besides, a telescope with photographed scale, two or three flint prisms and a direct vision prism. The instrument is also provided with a position circle reading to  $\frac{1}{3}^{\circ}$ . The price of the instrument varies according to the disposition of the telescope to which it is to be adjusted 11 to 1300



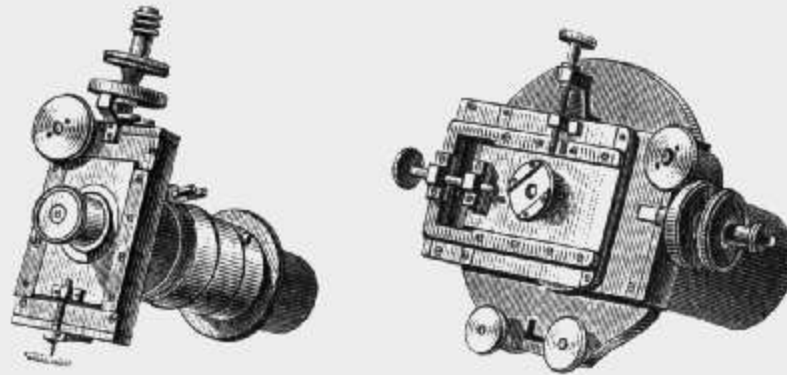
1820.

Nos

Francs.

§ 19. **Astronomical micrometers.**

- 1900. **Micrometer microscope**, with an ocular micrometer and a movable thread regulated by a screw . . . . .100 to 130
- 1910. **Position micrometer**, with movable eye-piece. Fixed threads and one movable thread, a register of the turns; according to the size (*fig.*). . . . .200 to 500
- 1920. **Do.** with two movable threads and two micrometer screws, a turn register . . . . .300 to 700



1910.

- 1930. **Ocular microscope** with long focal distance and a reflecting plate **to determine the nadir** by a mercury bath . . . . . 55

**Micrometers.** see *General measuring instruments* § 02, and *Optics* § 24.

## CHAPTER 2.

## OPTICS.

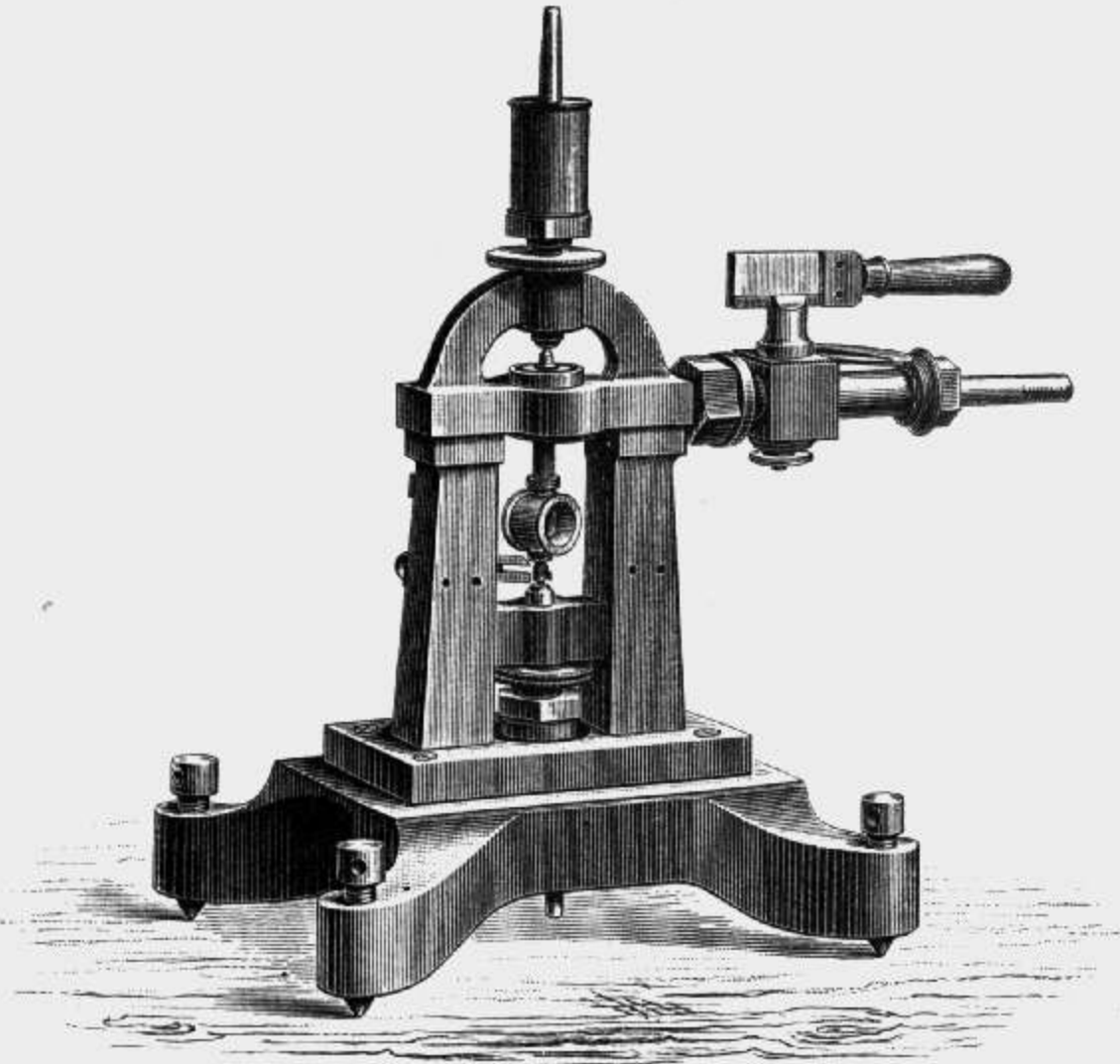
- § 20. Photometry.  
 21. Reflection and Refraction.  
 22. Spectrometers and Spectroscopes.  
 23. Simple Microscopes.  
 24. Compound Microscopes.  
 25. Accessories for Microscopes.  
 26. Object and Eye-glasses.  
 27. Telescopes.  
 28. Interference and Polarization.  
 29. Various Apparatus (of projection, photography, phosphorescence, etc.).

Nos		Francs.
<b>§ 20. Photometry.</b>		
2000.	<b>Rumford's Photometer</b> with divided scales . . . . .	50
2010.	<b>Bunsen's Photometer</b> mounted on a wooden rule 180 centim. long, with scale giving the intensities of light and mirrors . . . . .	100
2020.	<b>Do.</b> on an iron bench 140 centim. long, with scale giving the intensities of light . . . . .	120
2030.	<b>Do.</b> on an iron bench 3 metres long. Rolling carriage with regulating screw, for holding Lummer's photometric apparatus or Bunsen's box. Contrivance for measuring the light emitted at any angle by incandescent lamps . . . . .	600

Nos	Francs.
2040. <b>Foucault's Photometer:</b> diaphragm moved by a rack and pinion; the distances of the lights are measured with a tape . . . . .	55
2050. <b>Do.</b> mounted on two rods with hinges, bearing a scale . . . . .	125
2060. <b>Lummer and Brodhun's Photometer.</b> The rays of light falling on two opaque photometric screens are reflected on two prisms, so constructed that the image of one of the screens appears distinctly framed in by the image of the other screen, which makes the comparison of intensities very easy. The two screens are reversible. The photometric box can be mounted on a photometer bench . . . . .	150

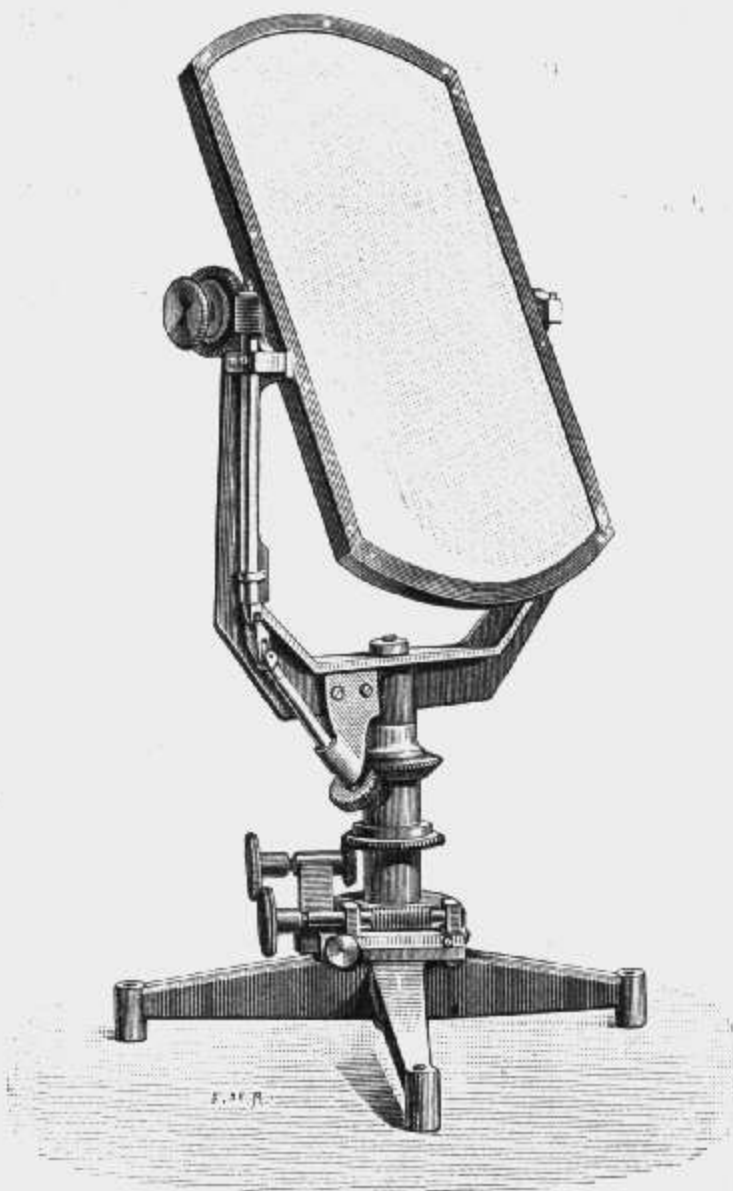
### § 21. Reflection and Refraction.

2100. <b>Simple Apparatus with dial and moving mirror</b> for the demonstration of the law of reflection on plane surfaces	25
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2110.

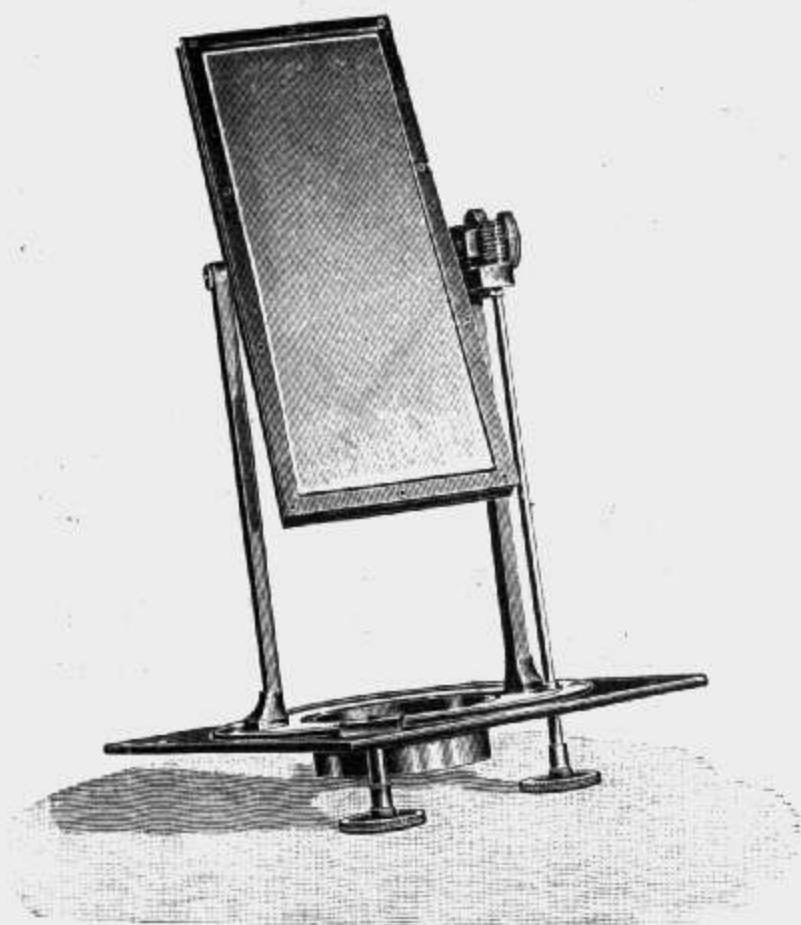
Nos	Francs.
2105. <b>General Apparatus</b> for the demonstration of the <b>laws of reflection and refraction</b> . . . . .	200
<b>Jamin's Circle.</b> (See : <i>Interference and Polarization</i> , § 28.)	
2110. <b>Foucault's Apparatus</b> , with revolving mirrors, moved by a small air turbine ( <i>fig.</i> ). With a pressure of one half atmosphere, a speed of about 500 revolutions per second is obtained. A pressure of 2 or 3 atmospheres can produce a speed of 1000 revolutions per second. (See : <i>Recueil des travaux de Foucault.</i> ) .	600



2120.

2115. **Clockwork Movement**, with regulator, designed especially to be used in connection with the preceding instrument, to repeat Foucault's experiments on the velocity of light. Toothed

Nos	Francs.
discs 80 millim. in diameter with 200, 400 and 500 teeth, making 2 revolutions a second. . . . .	400
<b>2120. Light-shedding Mirror for laboratory.</b> Mirror 18 by 35 centim. mounted on a cast iron tripod; movements in both directions are produced by tangent screws ( <i>fig.</i> ) . . .	170
<b>2125. Light-shedding Mirror for the Camera Obscura,</b> 270 by 105 millim., fixed to the shutter by four screws; with two mirrors, one being of black glass; moving in both directions ( <i>fig.</i> ). . . . .	200



2125.

<b>2130. Foucault's heliostat</b> with round mirror 30 centim. dia- meter. Can be adapted to different latitudes ( <i>fig.</i> ) . . . . .	900
<b>2135. Wollaston's camera lucida</b> , for drawing from nature, landscapes and objects of natural history, in case . . . . .	75
<b>2140. Prism cut at 60°</b> , mounted on a jointed foot . . . . .	50
<b>2145. Two mounted prisms</b> for the demonstration of achro- matism . . . . .	60

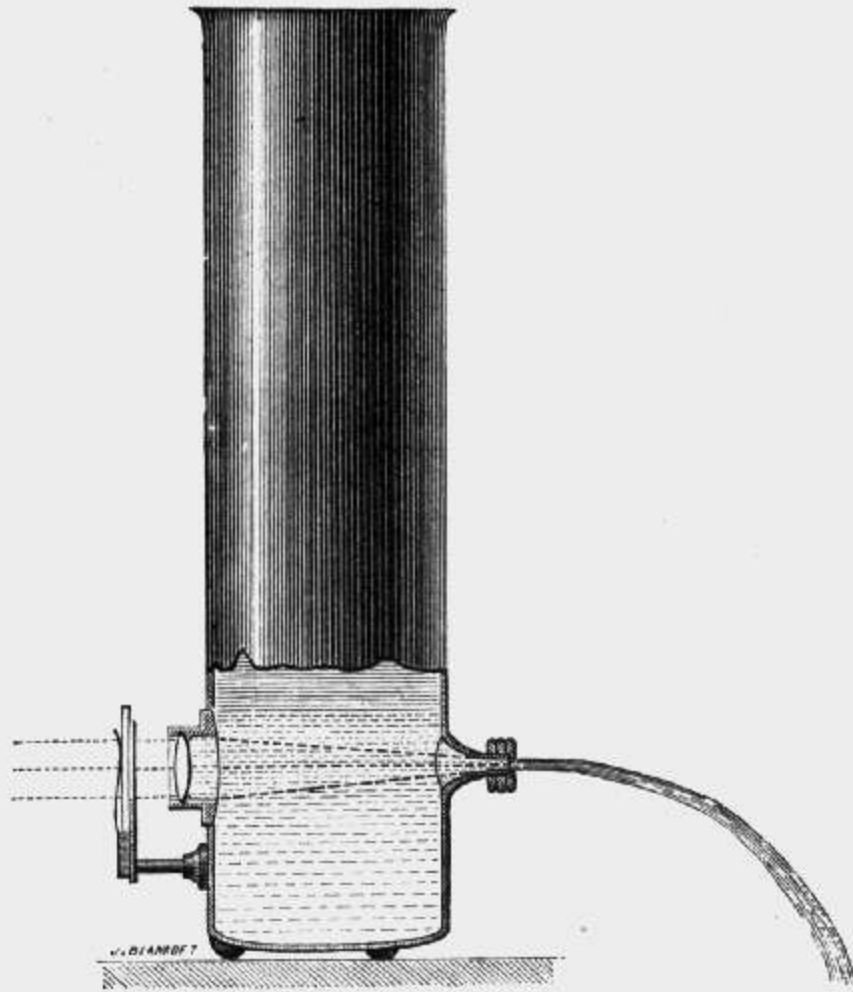
Nos	Francs.
2150. <b>Total reflection Prism</b> , mounted on a jointed brass foot	50
2155. <b>Colladon's Fountain</b> for the illumination of a fluid vein by total reflection. Reservoir of water 30 cent. in diameter, 90 centim. high : support for adapting coloured glasses. The apparatus can also be worked with gas light ( <i>fig.</i> ) . . . .	100



2130.

2160. <b>Arago and Biot's Apparatus</b> to determine the index of refraction of gases . . . . .	280
2165. <b>Lenses mounted</b> on a sliding foot ; 70 millim. in diameter ; concave or convex. One lens and its support . . . . .	25
2170. <b>Four Lenses mounted</b> on a rod supported by a foot, to demonstrate the course of rays in telescopes and microscopes	60
2175. <b>Optic Bench</b> 140 centim. long ; apparatus for demonstrating the laws relating to the focus of lenses and mirrors, and for measuring focal distances approximately . . . . .	180

Nos		Francs.
2180.	<b>Focal distance measuring Apparatus</b> for converging lenses, for a maximum distance of 30 centim . . . .	80



2155.

## § 22. Spectrometers and Spectroscopes.

**Goniometers.** (See : *General measuring instruments*, chapter 0, § 04.)

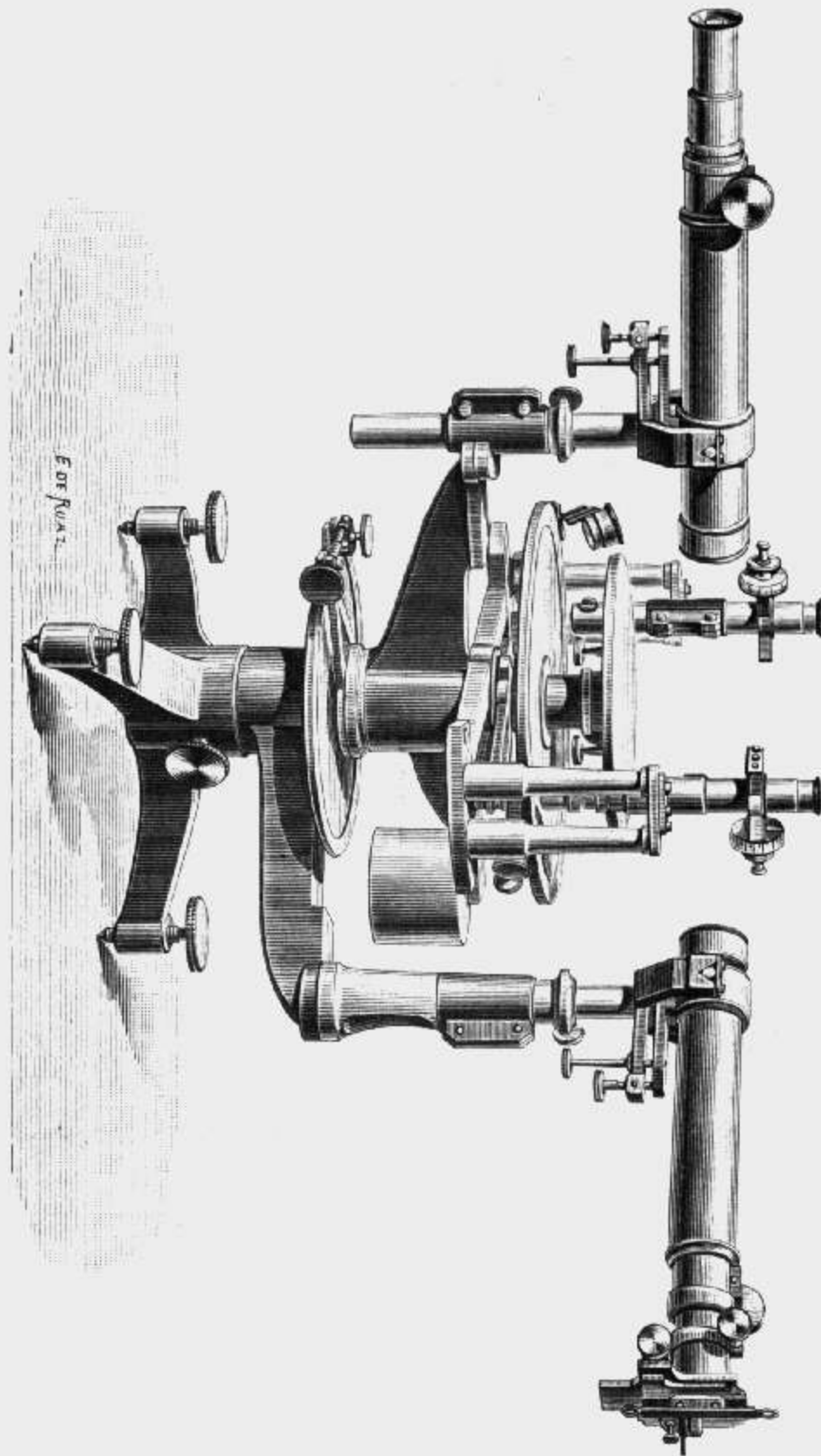
2200. **Spectrometer** of great precision, circle 255 millim. in diameter, divided into  $\frac{1}{12}^{\circ}$ , and alidade bearing two micrometer microscopes reading to 1". The circle is movable, and can serve as repeating circle. The telescopes 33.5 millim. aperture, can be raised or lowered according to the height of the objects placed on the shelf. The shelf moves independently of the circle and the alidade. The whole instrument, turning



Nos

Francs.

round a lower axis is of easy orientation. Symmetrical slit with comparison prism, ocular with reflector, adjustable prism 50 millim. (*fig.*) . . . . . 1500



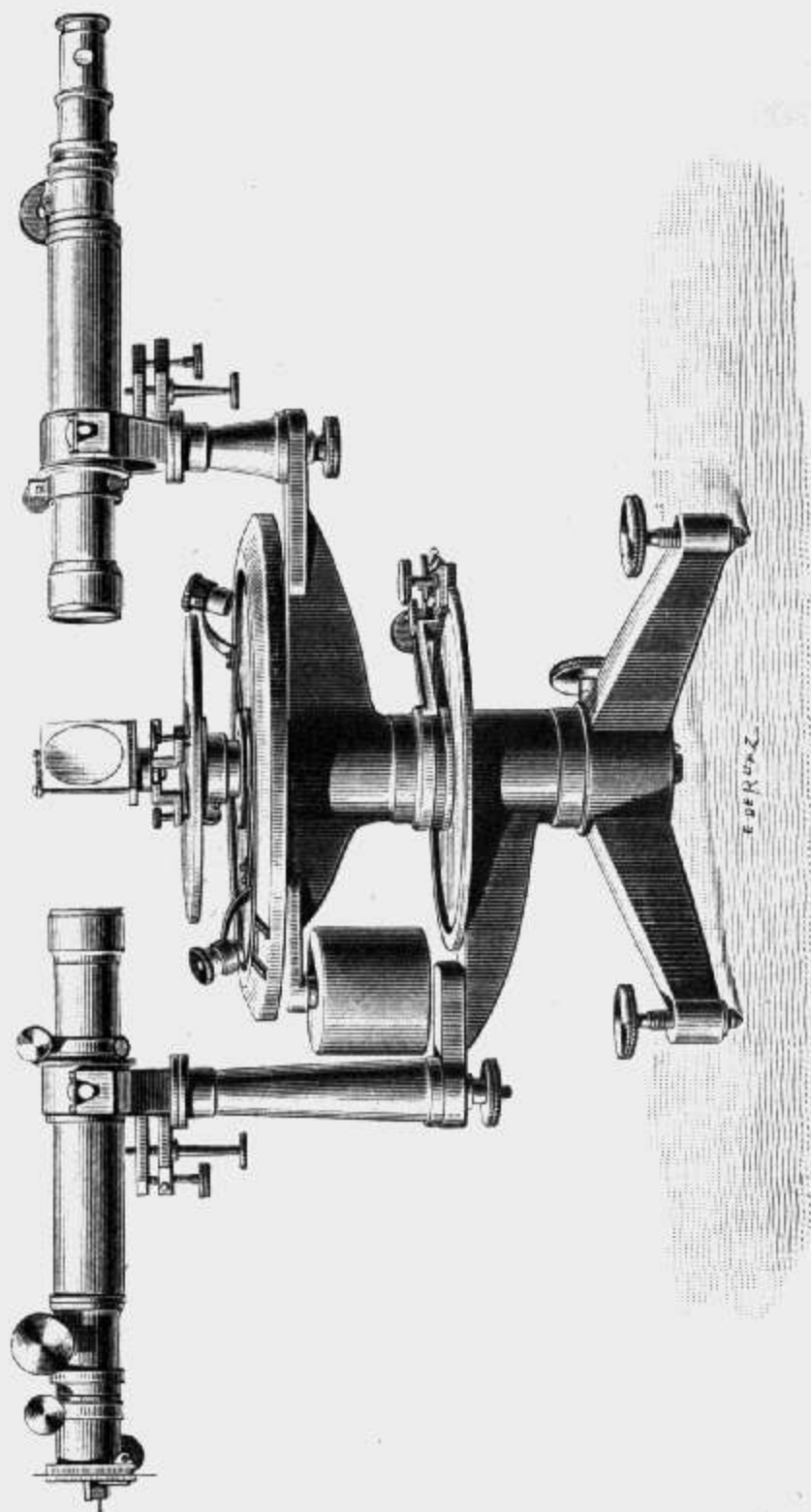
2200.

2205. **Spectrometer.** Same construction and dimensions, except that the microscopes are replaced by two verniers reading to 10'' . . . . . 1250

Nos

Francia.

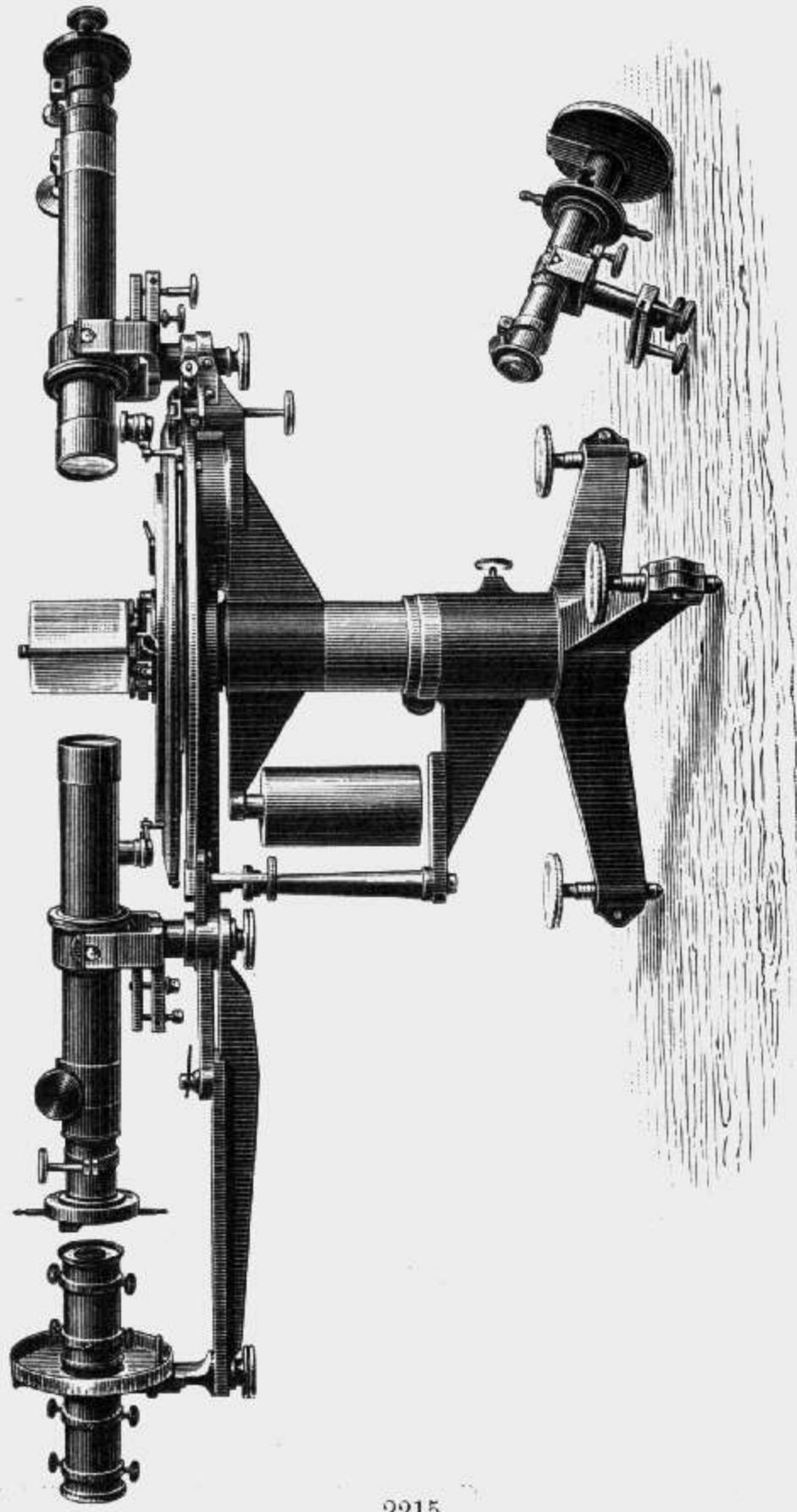
**2210. Laboratory Spectrometer,** Bunsen's model with a stationary circle 27 centim. in diameter, divided into  $\frac{1}{6}^{\circ}$ ;



2210.

verniers reading to  $10''$ . Object-glass with 325 millim. focal distance and 33,5 millim. aperture. Slit, with comparison prism, opening right and left symmetrically. The apparatus is provided with a turning shelf, which can hold several

prisms. Two oculars, one of which having a reflector. The whole instrument can turn round a vertical axis. A single prism is supplied with the instrument (*fig.*) . . . . . 850

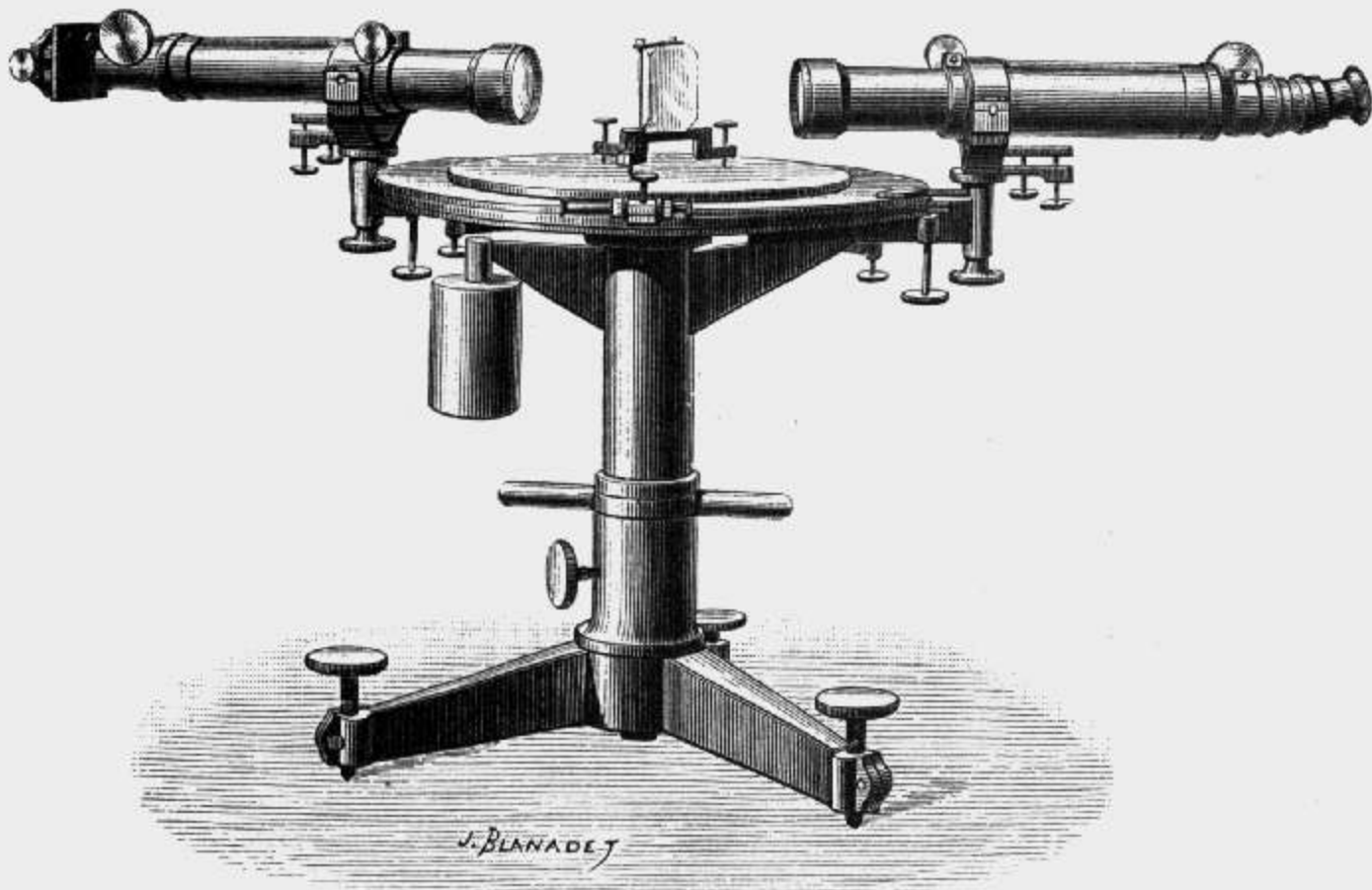


2215.

Nos

Francs.

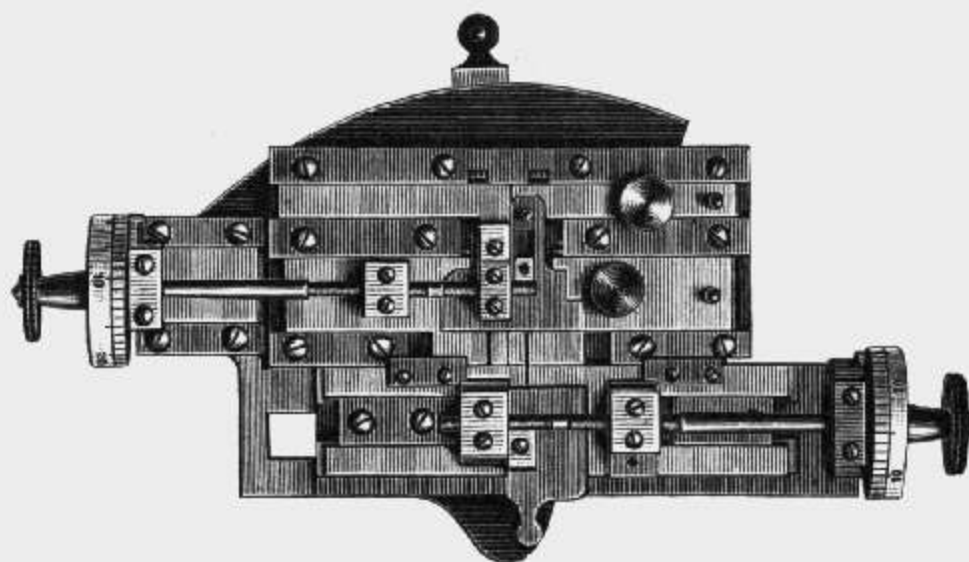
2211. **Adjunction** to the above instruments of a polarization apparatus, composed of two Nicol's prisms and provided with two position circles 100 millim. in diameter, divided into degrees on silver; vernier reading to  $\frac{1}{10}^{\circ}$ ; Babinet's compensator for elliptical polarization . . . . . 300
2212. **Adjunction** to the above instruments of an optical part, whose object is the observation of the ultra-violet spectrum. The achromatic lenses and the flint prism are replaced by a set of quartz lenses and a 45 millim. quartz prism. The prism is automatically maintained at the minimum of deviation. The lens of the collimator is compensated for experiments with polarized light (see *Soret's Mémoire sur le spectroscopie à oculaire fluorescent. Arch. des Sciences phys. et nat.* 1876, t. LVII,



2220.

p. 330). The collimator and the telescope are provided with sights permitting the slit and the eye-glass to be focused on the main solar spectrum lines and the lines of cadmium, whose wave lengths have been determined by M. Mascart,

Nos	Francs.
and then on the extreme spectrum lines of zinc and aluminium. Soret's fluorescent ocular. . . . .	350
2215. <b>Spectrometer</b> with adjunction of a polarization apparatus to serve as Crova's spectrophotometer (see <i>Annales de Chimie et de Physique</i> , fifth series, 1880 and 1881 ( <i>fig.</i> ) . . . . .	1000
2220. <b>Laboratory Spectrometer.</b> Model designed for ordinary practice of students. Stationary circle divided into $\frac{1}{6}^\circ$ , a single vernier reading to $20''$ . Telescopes 30 millim. aperture and 340 millim. focal distance, moving both ways. No orientation axis and a single prism mounted on a plate with three levelling screws ( <i>fig.</i> ) . . . . .	550
2221. <b>Do.</b> same model with quartz prism and lenses for observing the ultra-violet spectrum . . . . .	600
2222. <b>Adjunction</b> to the above models of an ocular micrometer with a movable thread . . . . .	50
2225. <b>Donder's coupled Slits</b> , for the mingling of any two spectral colours ( <i>fig.</i> ) . . . . .	250



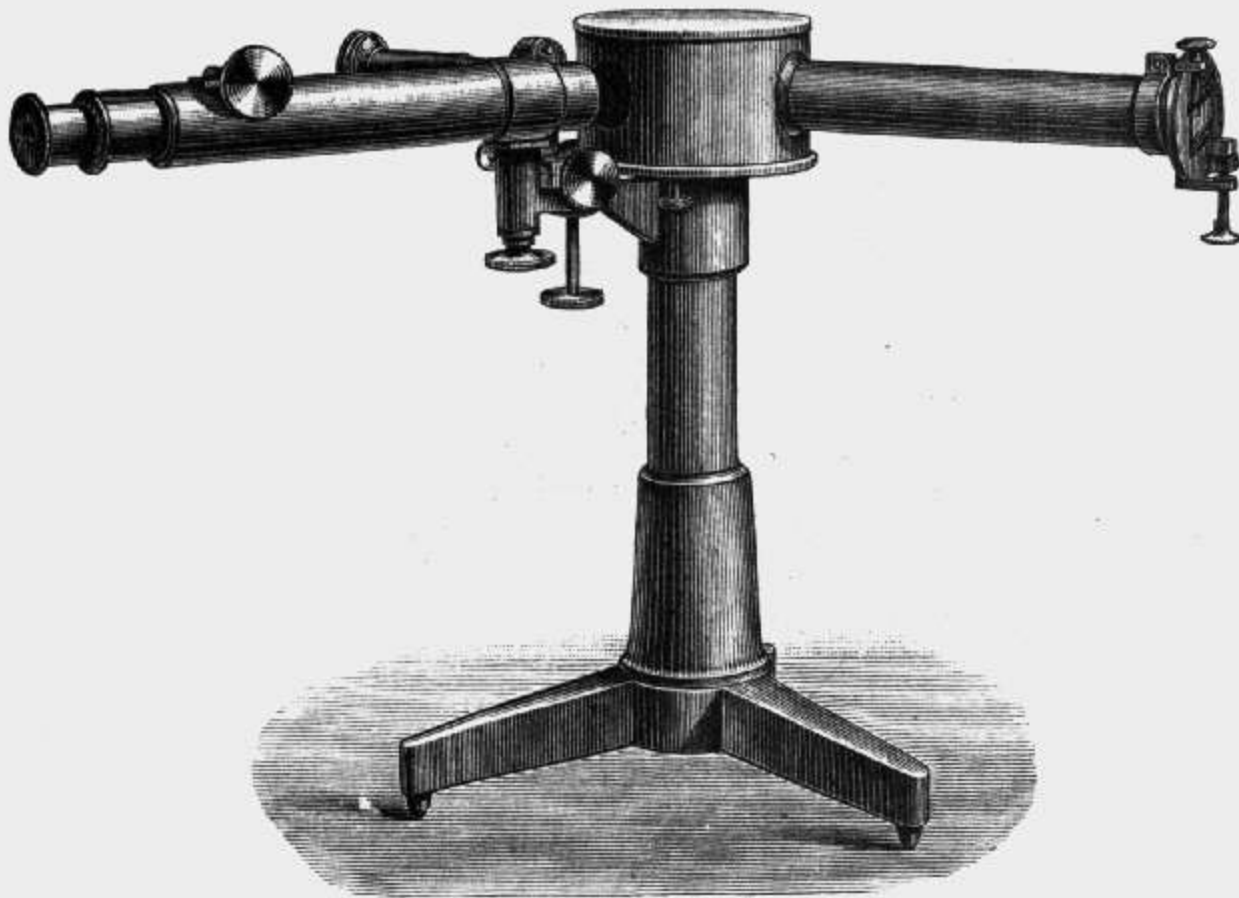
2225.

2230. <b>Spectroscope.</b> small model, specially used to observe the ultra-violet spectrum; no graduated circle. Quartz prism 35 millim., quartz lenses, movable slit and comparison prism; mounted on a sliding foot with hinges and supplied with Soret's fluorescent ocular . . . . .	300
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Nos

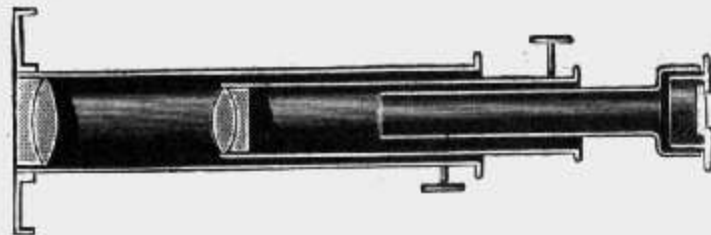
Francs.

2235. **Spectroscope** with 40 millim. flint prism having round surfaces ; no graduated circle, small telescope and transparent scale. Object-glasses 27 millim. in diameter. Contrivance for placing the prism at the minimum of deviation ; double horizontal movement and vertical movement for the tube ; comparison prism (*fig.*) . . . . . 300



2235.

2236. **Do.** with adjustable scale and dispersion, of M. A. de Gramont (see *Comptes Rendus, Acad. des Sc., Paris, June 26<sup>th</sup> 1899*). Same apparatus as above, the telescope only being modified as shown in *fig.* 2236 . . . . . 350



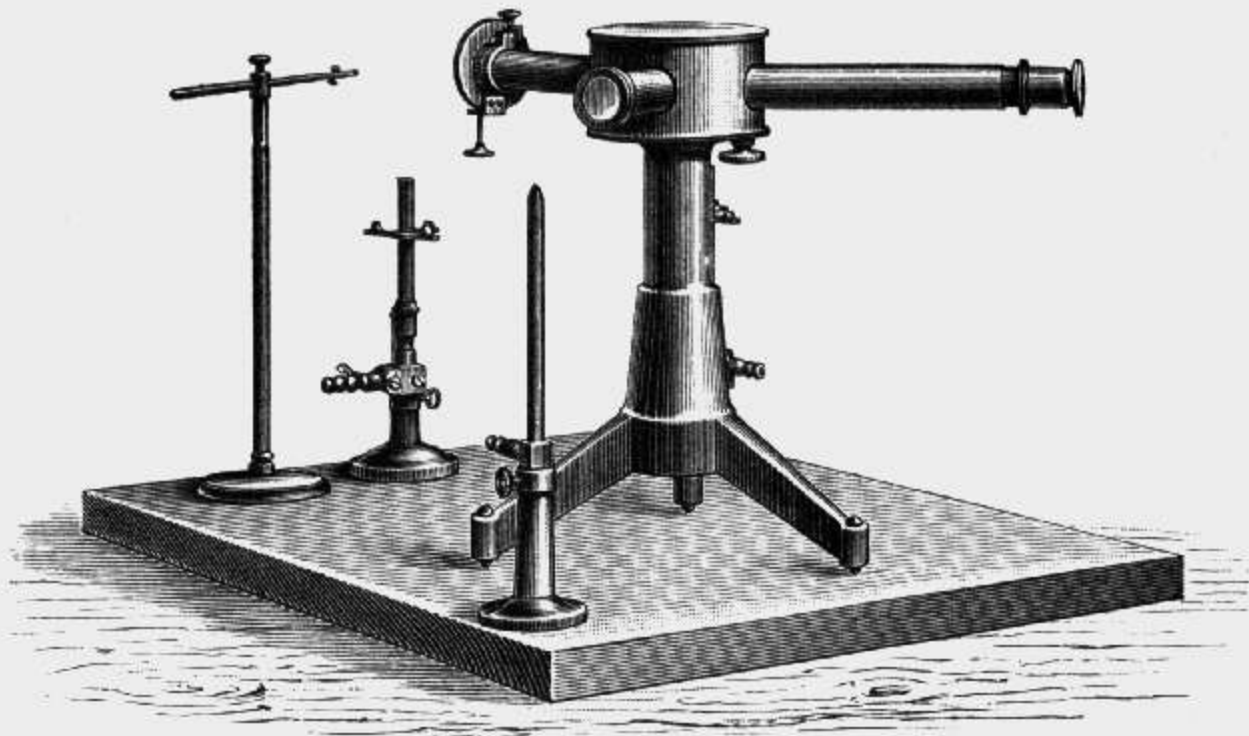
2236.

2240. **Do.** with two dense flint prisms . . . . . 450

Nos

Francs.

2245. **Spectroscope for Chemists**, small model; 35 millim. flint prism with round surfaces. Object-glasses 23 millim. in diameter; scale telescope and comparison prism. Two Bunsen's burners, a support for holding the objects to be burnt, a lamp for illuminating the scale; all these different pieces are fixed on a board in their respective positions (*fig.*). 200



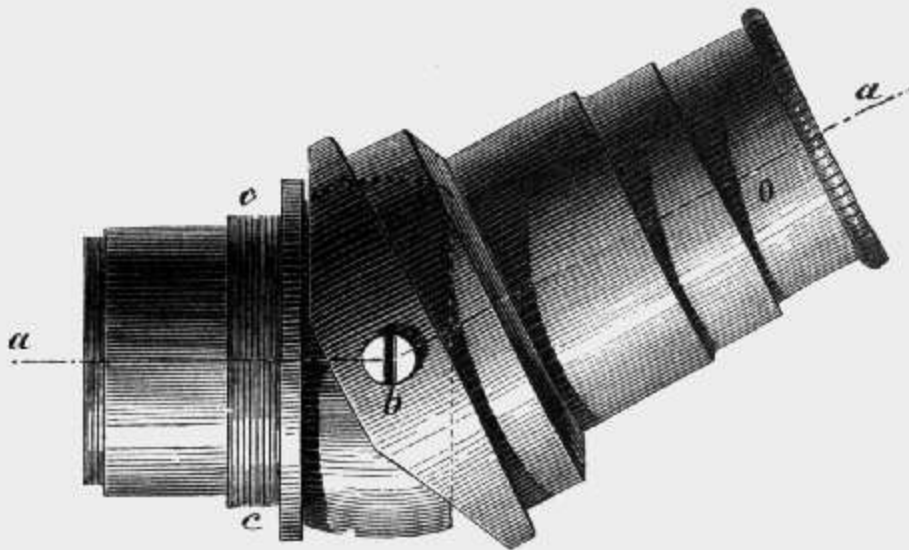
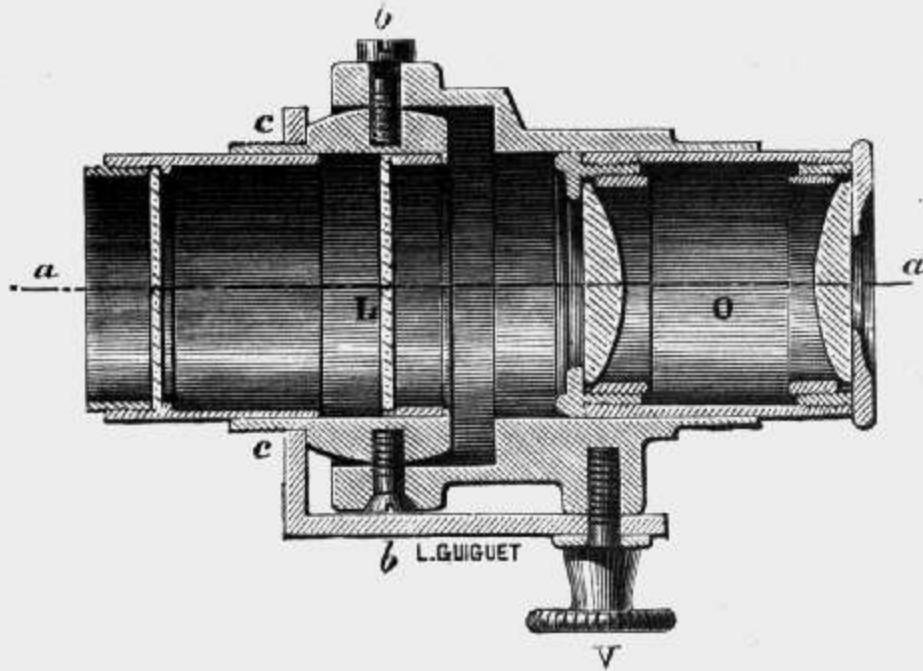
2245.

2246. **Do.** without accessories . . . . . 170
2250. **Do.** smaller model; prism, 30 millim. . . . . 130
2255. **Direct vision Spectroscope**, with Amici's prism, composed of three or five prisms; scale telescope, comparison prism; mounted on a jointed foot . . . . . 225
- Astronomical Spectroscopes**, see *Astronomy* § 18.
2260. **Prism** for liquids, mounting with three levelling screws . . . . . 50
2265. **Bunsen's Burner** for spectroscopes . . . . . 9
2270. **Support with a foot** for holding in a flame bodies to be examined by the spectroscope . . . . . 8
2275. **Achromatic Projection Lens**, 50 to 100 centim. focal distance and 45 to 65 millim. diameter; mounted on a sliding foot . . . . . 35 to 45

Nos

Francs.

2280. **Small Apparatus** for bringing together micrometrically two metallic points, in order to obtain the spectrum of metals by an induction spark . . . . . 60



2285.

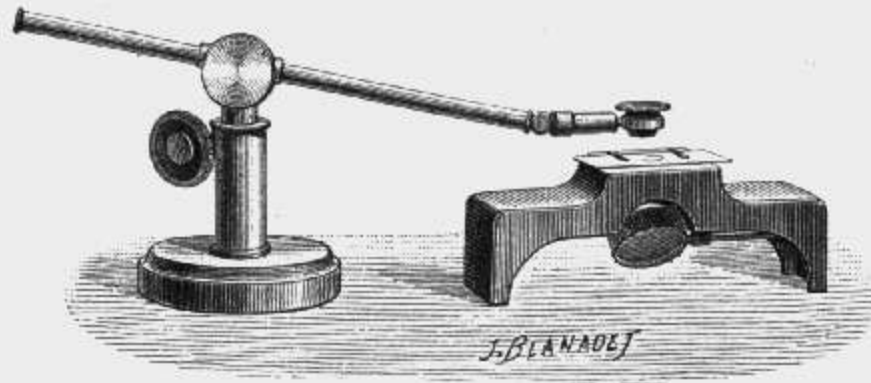
2285. **Soret's fluorescent Ocular**, adjustable to most spectroscopes and permitting the study of the ultra-violet spectrum. The principle of the instrument consists in placing in the tube of the spectroscope, at the focus of the object-glass, a transparent and fluorescent lamella, on which the spectrum is formed and the latter is observed by means of a positive sight inclined at an angle with the axis of the tube. The sight complete, a mounted uranium glass plate, two screw boxes closed by white glass plates to receive the fluorescent liquids,



Nos	Francs.
a blue glass to absorb the less refrangible rays; the whole complete ( <i>fig.</i> ) . . . . .	45

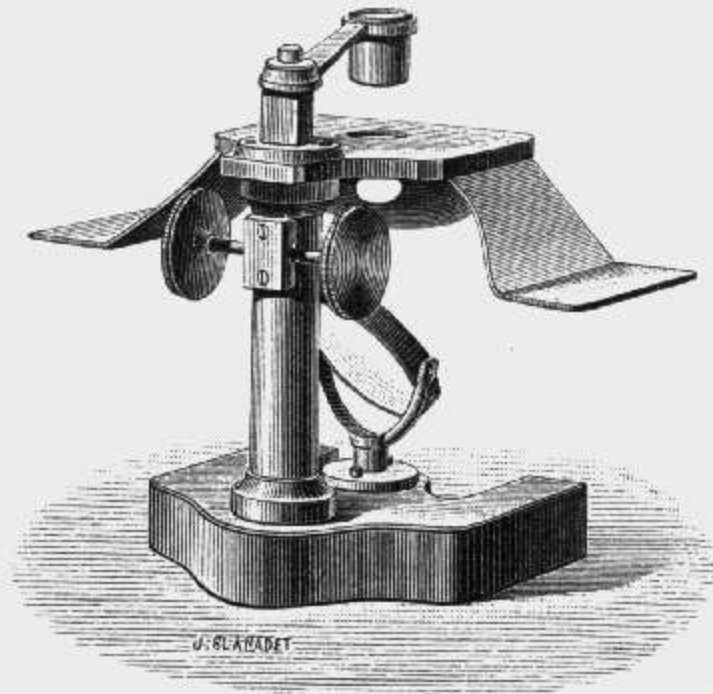
**§ 23. Simple Microscopes.**

2300. <b>Magnifying Glass</b> with horn mounting . . . . .	3
2310. <b>Simple Microscope</b> , with arm and dissecting shelf independent of the stand for the magnifying glass; rack and pinion adjustment for focusing; three doublets; in a case lined with velvet ( <i>fig.</i> ) . . . . .	90



2310.

2320. <b>Simple Microscope, laboratory model</b> , of great stability, on a cast iron pedestal. Plate 80 millim., concave mirror 45 millim. in diameter; the plane mirror is replaced by a white enamel slab; rack and pinion; without doublets and without box ( <i>fig.</i> ) . . . . .	50
---	----



2320.

Nos	Francs.
2330. <b>Simple Microscope</b> , same model as the preceding. The shelf can be replaced by a glass slab; a screen being placed underneath produces a white or black ground. Doublet moving in any direction in a horizontal plane. In a case with three doublets . . . . .	100
2340. <b>Simple Microscope</b> , especially designed for travelling, lighter than the preceding; doublet moving in any direction in a horizontal plane; the dissecting shelf can be replaced by a glass plate, or by piers mounted on two axes, which intersect at the focus of the doublet; by this arrangement, an object can be examined on every side in a very short time, without being unfocused. With three doublets, the whole in velvet lined case. The instrument can be fixed on its case, or on a special support for the dissection . . . . .	145
2350. <b>Each Doublet</b> . . . . .	7
2360. <b>Achromatic Doublets</b> . . . . .	10 to 20
2370. <b>Projection Microscope</b> , three magnifying powers; fitting the light-throwing mirror n <sup>o</sup> 2125 or the projection lantern n <sup>o</sup> 2900 . . . . .	150

## § 24. Compound Microscopes.

### 2400. **Microscope, large model** (*fig.*).

This instrument can be employed in three different positions, vertical, horizontal and slanting.

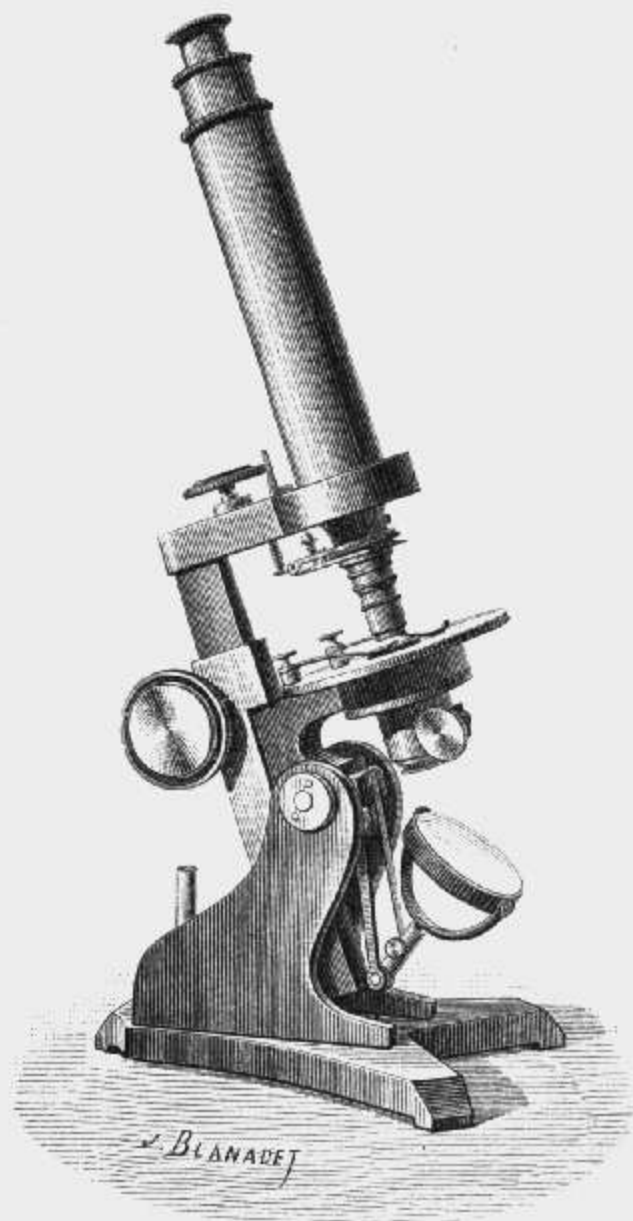
Abbe's condenser moved by means of a rack and pinion. The concentrating apparatus turns round an eccentric axis and can be rapidly removed.

Plate covered with a glass lamella turning independently of the tube.

The preliminary adjustment is effected by means of a rack and pinion, and the final focusing by means of a screw with divided head acting on the object-glass tube by means of a lever. Should the observer, accidentally, bring the object-glass in contact with the plate and continue turning the focusing

screw, the object-glass tube is permitted to slide back into the body of the instrument by the yielding of a spring, and an accident is thus prevented.

The object-piece is not screwed on the tube, it is merely pressed by spring piers against a carefully adjusted bearing. To remove the object-piece, one has only to slide it crossways, pressing at the same time in the direction of the axis of the



2100.

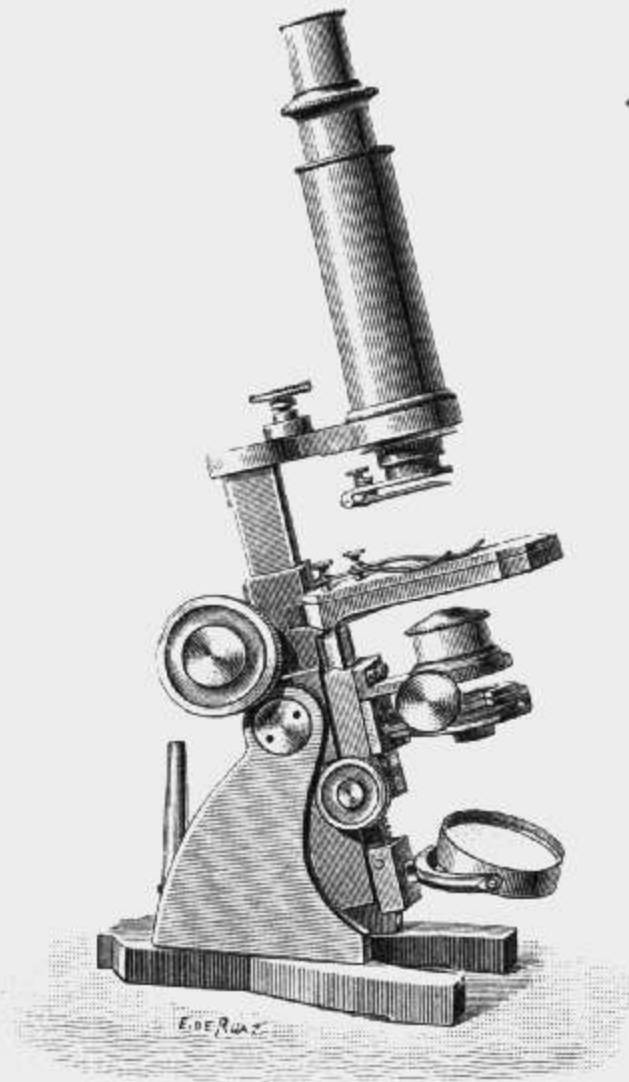
microscope. The object-piece is put back into its place with still greater facility. The advantages resulting from these contrivances are the following: 1<sup>st</sup> A great saving of time for the observer, the magnifying power being changed instantaneously; 2<sup>d</sup> A mechanical centering of the object-piece much more perfectly than any that could be obtained with a screw;

Nos

Francs

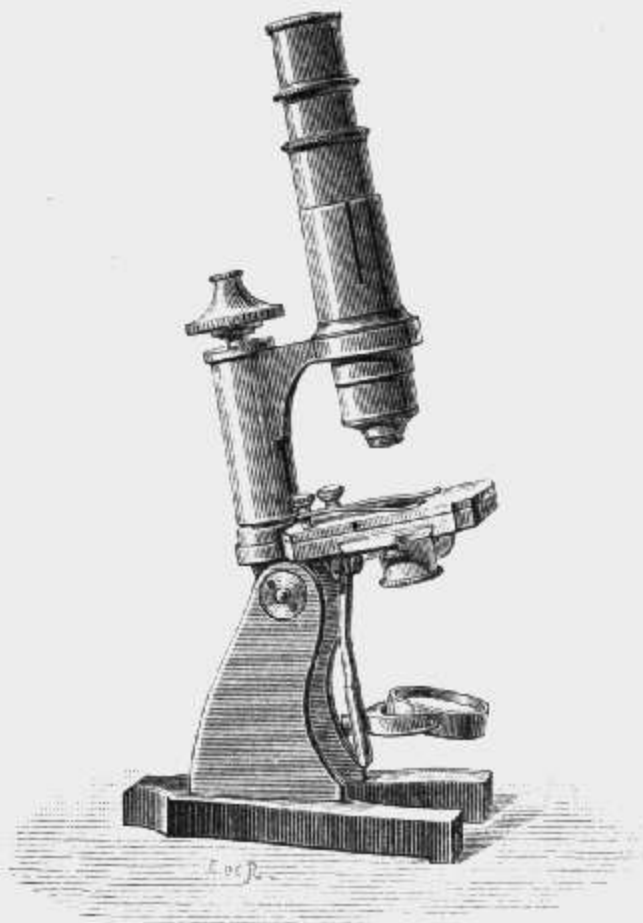
the defects of centering being immediately perceived can be partly corrected; 3<sup>d</sup> The observer can easily choose the position of the objective that produces the best images, when oblique lighting is used . . . . . 350

2405. **Microscope, second large model** Construction similar to the preceding, but lighter. Plate 85 millim. square : object-piece plyers, Abbe's condenser ; in a case (*fig.*). . . . . 250

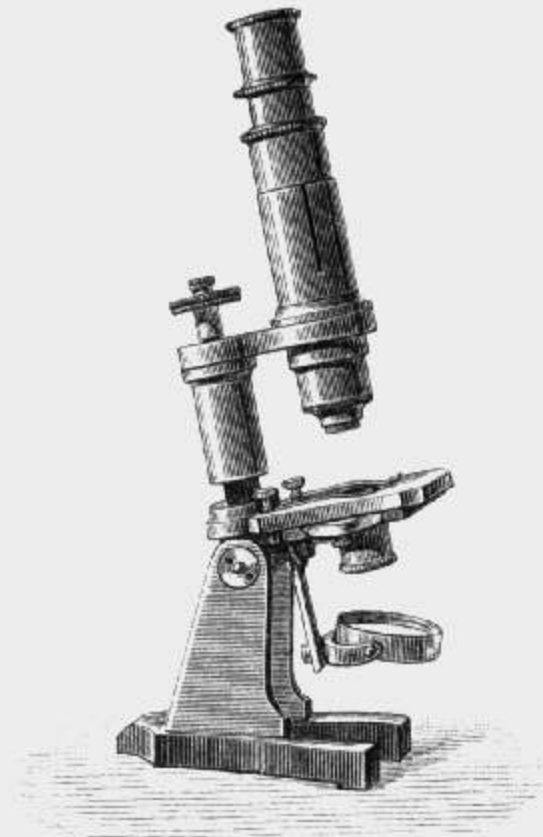


2405.

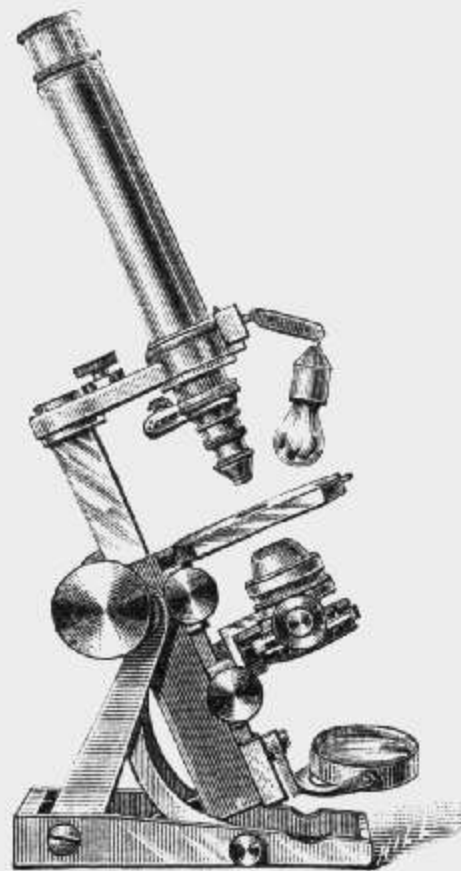
2410. **Microscope** inclinable, shelf  $72 \times 85$  millim.; rapid adjustment by a slide, fine adjustment by a micrometer screw ; Abbe's condenser ; height to the eye-glass 32 centim. ; without case . . . . . 170
2415. **Microscope**, same model as above, but without condenser ; pump diaphragms with lighting lens mounted on a slide-block ; without case (*fig.*). . . . . 125
2420. **Microscope** small model, inclinable, shelf  $60 \times 75$  millim.,



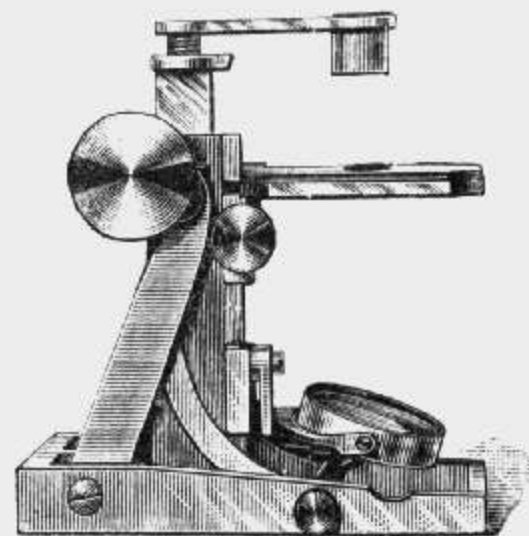
2415.



2420.

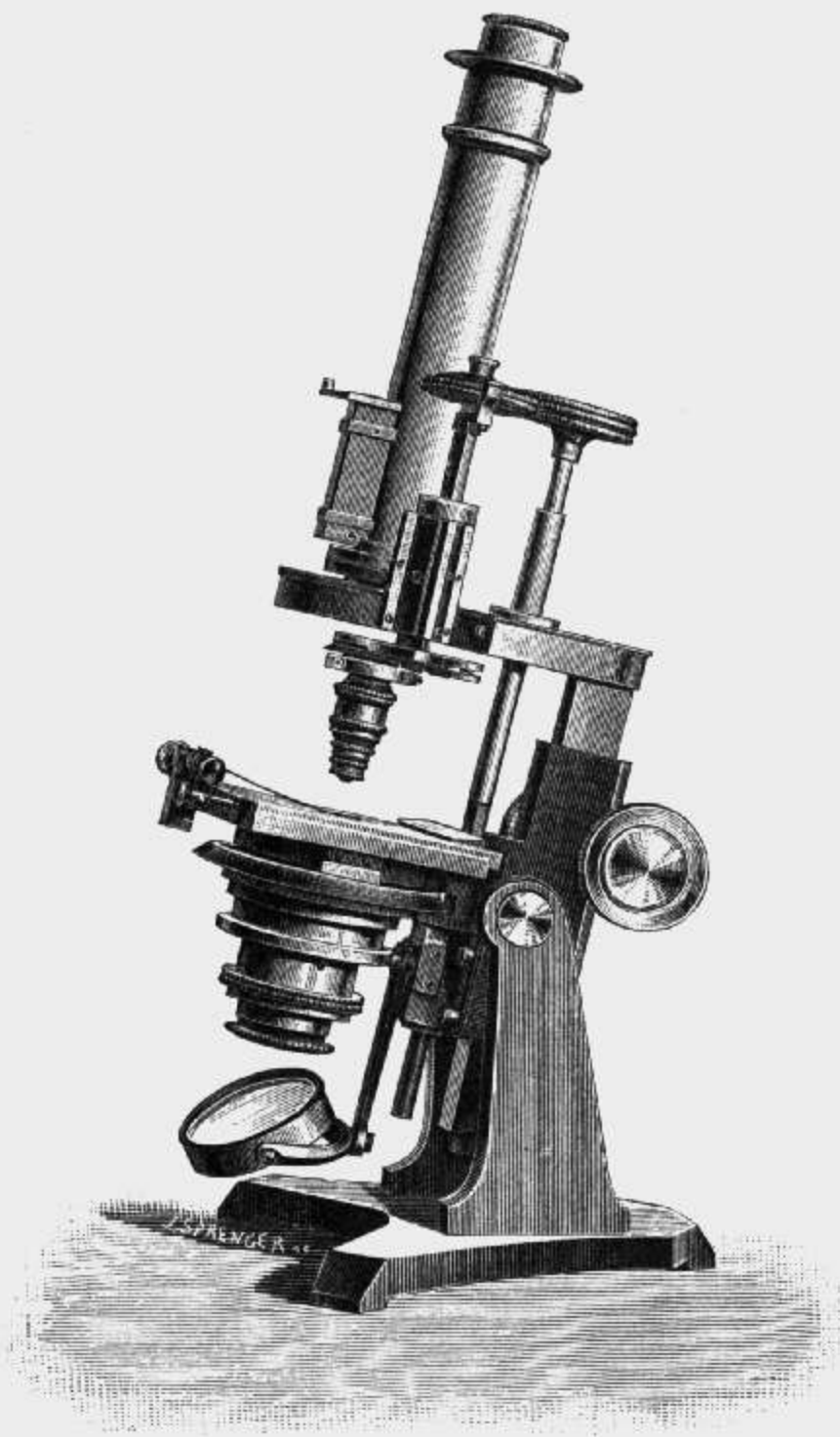


2430 a.



2430 b.

Nos	Francs.
pump diaphragm and lighting lens mounted on a slide-block, height to eye-glass 28 centim. : without the case ( <i>fig.</i> ) . . .	85
<b>2425. Microscope</b> , same model as the preceding, no inclining arrangement; without the case . . . . .	75

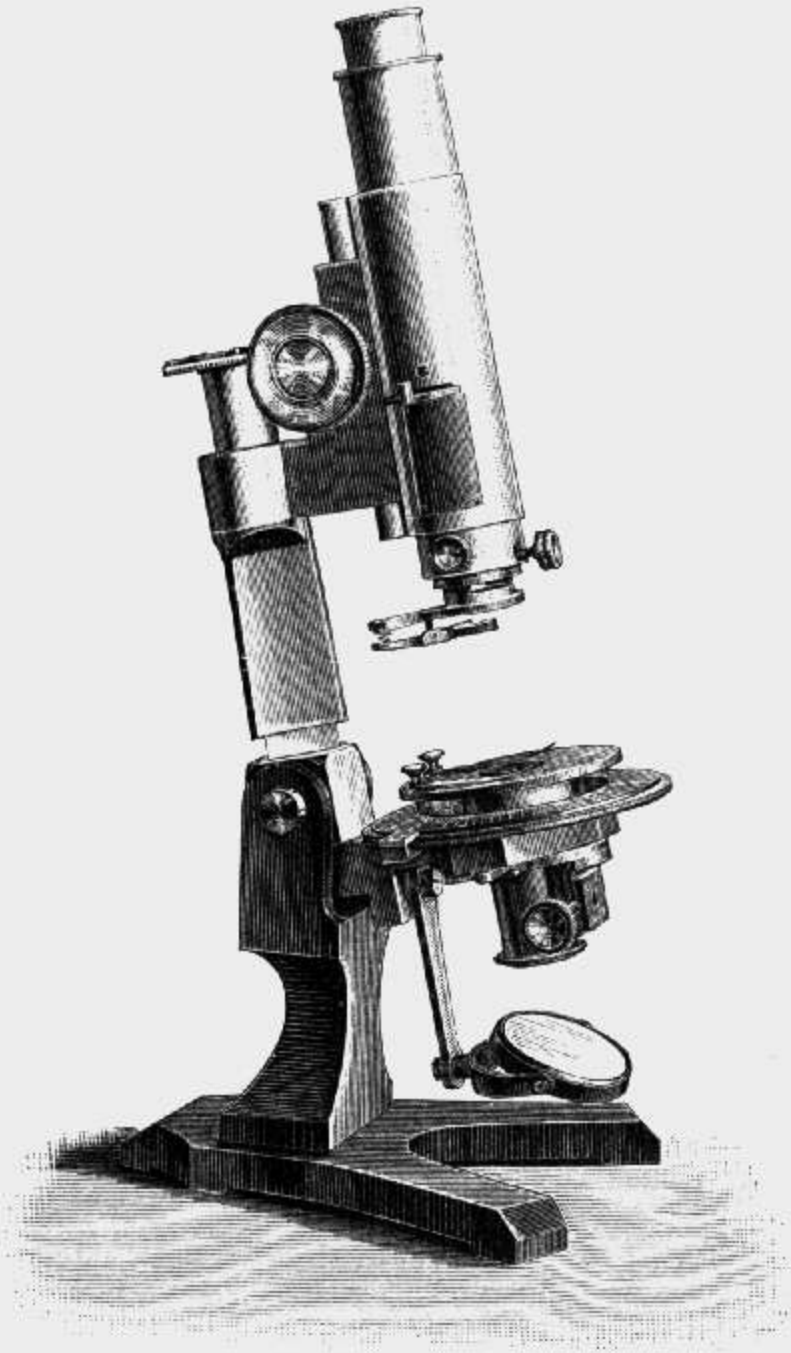


2435.

<b>2430. Travelling Microscope</b> , large size, reduced to a small bulk by the easy dismounting of its component parts. The instrument can also be used as simple microscope for dissection; leather case: without glasses ( <i>fig. a et b</i> ) . . . . .	300
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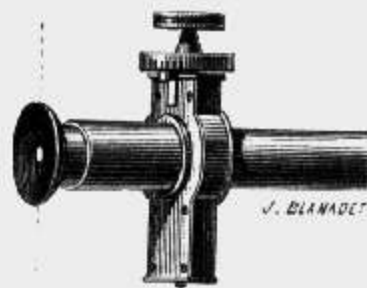
Nos	Francs.
2435. <b>Microscope for Mineralogists.</b> Model strongly constructed, inclinable, with a shelf 85 millim. square ( <i>fig.</i> ).	
<p>Nicol's prisms with rectangular surfaces; the polarizer can be removed, the analyzer inside the tube, behind the object-piece can be easily slipped to one side. The object to be examined does not turn; the Nicol's prisms alone can be turned together by means of cog-wheels, worked by a screw-button. A graduated circle, with a vernier reading to 1 minute, indicates the position of the polarizers with regard to the object. Rapid change of parallel light into converging light by lenses mounted on a slide. The variation of the focus produced by the Nicol's prism is corrected by a lens. Opening behind the objective to introduce mica or quartz lamellæ &amp;c. Centering and plyers for objectives.</p> <p>Two reticule oculars; their azimuthal position with respect to the Nicols, is determined by shades. Bertrand's ocular. In a case; without objectives . . . . .</p>	
	850
2440. <b>Microscope for Mineralogists.</b> Laboratory model: ordinary construction, strong, with stationary Nicol's prisms and a turning shelf ( <i>fig.</i> ).	
<p>Rough adjustment of the tube by a rack and pinion, fine adjustment by a screw with divided head. The lens system for converging light can be easily removed by a lever. In other respects, this instrument presents the same advantages as the preceding, but the Nicol's prisms are rather smaller.</p> <p>Two oculars and a Bertrand's ocular. The instrument without case or objective . . . . .</p>	
	500
2441. <b>Do.</b> With the case . . . . .	330
2442. <b>Adjunction</b> of an ocular with a Nicol's prism and a graduated circle; in case. The large Nicol's prism is not required.	30
2443. <b>Quartz Wedge</b> 1 <sup>st</sup> to 3 <sup>rd</sup> order . . . . .	21
2444. <b>Violet Quartz</b> , 2 <sup>nd</sup> order . . . . .	16
2445. <b>Gypsum Wedge</b> . . . . .	15
2446. <b>Mica Slide</b> $\frac{1}{4}$ wave length . . . . .	4
2447. <b>Blue and red glass Slide</b> . . . . .	4
2448. <b>Gypsum Slide</b> red, 1 <sup>st</sup> order . . . . .	6

Nos		Francs.
2450.	<b>Ocular Micrometer</b> with movable thread ( <i>fig.</i> ) . . . . .	80
2455.	<b>Objective Micrometer</b> , with brass mountings, divided into $\frac{1}{50}$ or $\frac{1}{100}$ millim . . . . .	10



2440.

2456.	<b>Do.</b>	divided into $\frac{1}{10}$ and $\frac{1}{20}$ millim. . . . .	8
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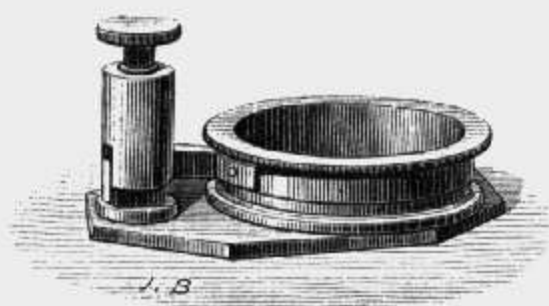


2450.

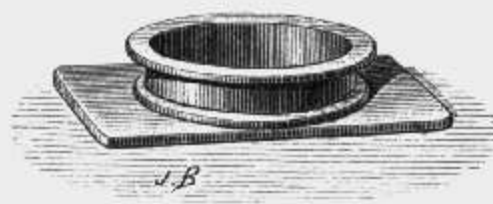


Nos	Francs.
2460. <b>Objective Pliers.</b> Can be adapted to all mostall microscopes. The use of these pliers is explained in the description of the large model . . . . .	20
2465. <b>Revolver</b> for rapidly changing two object-pieces . . . . .	25
<b>§ 25. Accessories for Microscopes.</b>	
2500. <b>Microtome with Micrometer-Screw</b> . . . . .	25
2505. <b>Large Microtome</b> for systematic sections. Slide-block 25 centimetres long . . . . .	130
2510. <b>Microscope Tube Holder</b> with shelf and pliers, for lectures . . . . .	25
2515. <b>Pad,</b> or hand-rest, for dissecting with a simple microscope . . . . .	3 to 5
2520. <b>Reel</b> for making divisions with a paint brush . . . . .	25
2521. <b>Do.</b> with brush-holder . . . . .	40
2525. <b>Camera Lucida</b> mounted on an independent stand for drawing with a simple microscope . . . . .	80
2530. <b>Doyère's Camera Lucida</b> for drawing with a compound microscope . . . . .	45
2535. <b>Movable Tablet</b> for drawing with a compound microscope by means of the camera lucida, adjustable to the size of the drawing, and capable of being inclined so as to avoid obtaining distorted images. . . . .	25
2540. <b>Lens for illuminating opaque bodies,</b> 50 millim. focal distance, and 60 millim. diameter; mounted on a jointed foot . . . . .	25
2545. <b>Parabolic Mirror,</b> in silver, for illuminating opaque bodies; used only with a weak magnifying power. . . . .	40
2550. <b>Illuminating Apparatus,</b> consisting of a glass lamella or a small steel mirror with a hole in the centre, for illuminating dark bodies through the object-glass . . . . .	20
2555. <b>Apparatus for photographing</b> with a microscope.	
2560. <b>Slide-holder</b> at constant temperature . . . . .	60
2565. <b>Compressors</b> (Ross's box) 15, 23, 30 and 40 millim. in diameter for the slide-holder lamella . . . . .	12 to 15

Nos		Francs.
2570.	<b>Schick's Compressor</b> . . . . .	30
2575.	<b>M. Thury's Compressor</b> , especially designed for the study of eggs and of the development of lower organisms . . . . .	45
2580.	<b>Do.</b> modified by H. Fol. Large model with micrometer screw ( <i>fig.</i> ) . . . . .	45
2585.	<b>Do.</b> another model, without micrometer screw ( <i>fig.</i> ) . . . . .	15



2580.



2585.

## § 26. Object- and Eye-Glasses for Microscopes.

A contract with Messrs. Seibert & Kraft at Wetzlar permits us to supply the best object-glasses at the same price as the makers.

The *Société Genevoise* undertakes also, if desired, to furnish object-glasses of any other make at prime cost.

### Object-Glasses.

Object-glass N <sup>o</sup>	Focal distance of the equivalent lense.		Angle of aperture.		
	Eng. inches.	Millim.			
2600.	00	2 $\frac{1}{2}$	63,5	40°	in the air . . . . . 30.—
2602.	00a	2 $\frac{1}{2}$	63,5	8°	» » . . . . . 15.—
2604.	0	4 $\frac{3}{4}$	44,4	15°	» » . . . . . 26.—
2606.	0a	4 $\frac{3}{4}$	44,4	12°	» » . . . . . 15.—
2608.	I	1	25,4	25°	» » . . . . . 22.50
2610.	II	$\frac{1}{2}$	12,7	30°	» » . . . . . 22.50
2612.	III	$\frac{1}{3}$	8,5	40°	» » . . . . . 22.50
2614.	IV	$\frac{1}{4}$	6,4	74°	» » . . . . . 34.—
2616.	V	$\frac{1}{7}$	3,6	128°	» » . . . . . 45.—
2618.	VIa	$\frac{1}{12}$	2,1	128°	» » without correction 75.—
2620.	VIb	$\frac{1}{12}$	2,1	128°	» » with » 94.—
2622.	VIIa	$\frac{1}{16}$	1,6	110°	in water, without » 75.—
2624.	VIIb	$\frac{1}{16}$	1,6	110°	» » with » 94.—



Nos

Francs.

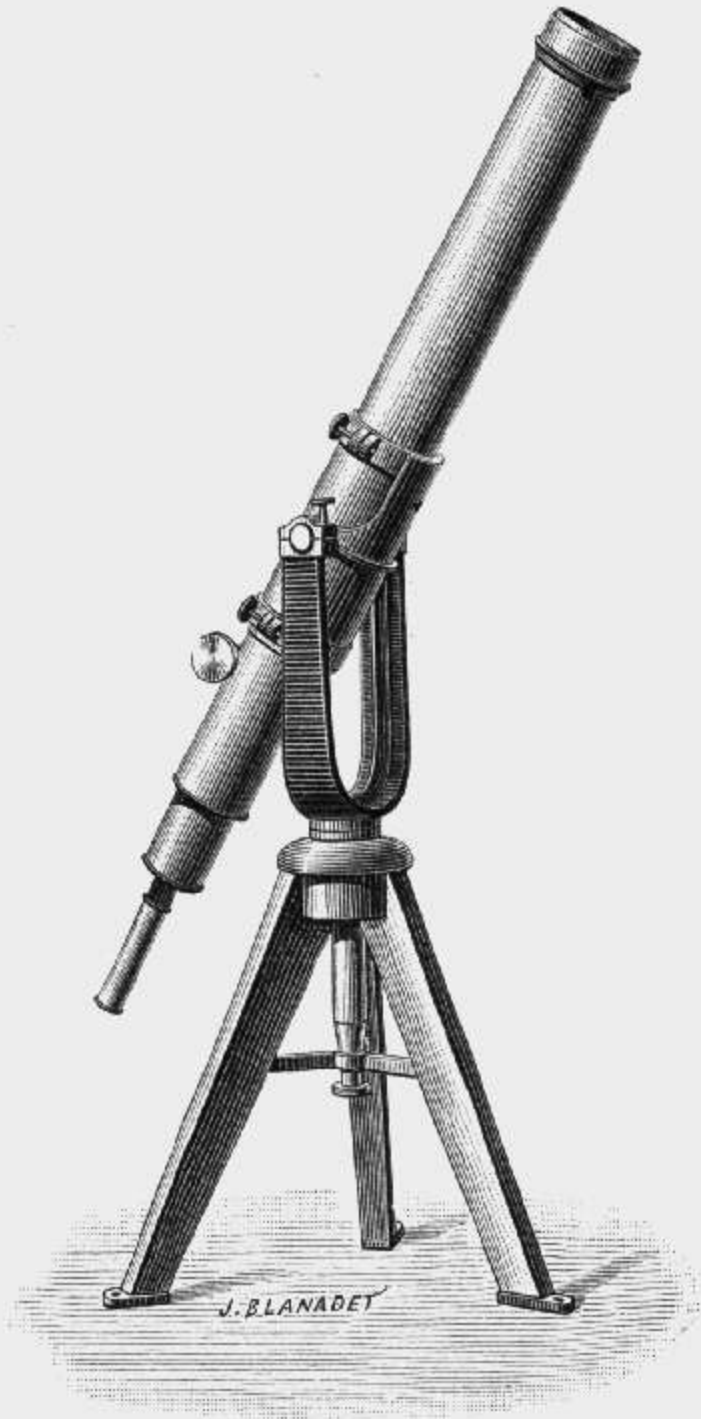
2705. **Telescope 67,5 millim. aperture.** Mounted on a wooden tripod, with rack and pinion, to stand on the ground. With walnut case for the telescope (*fig.*). . . . . 420



2705.

2710. **Astronomical Ocular** in addition . . . . . 12
2712. **Terrestrial Ocular** » » . . . . . 20
2714. **Ocular** for astronomical searcher, wide field, with three glasses . . . . . 25
2720. **Telescope, 81 millim. aperture.** Drawing room instrument, mounted on a polished wood tripod, standing on the ground; a brass pillar with rack and pinion for regulating the height; the tube of polished brass, or covered with leather, with two terrestrial oculars magnifying 40 and 80 times and two astronomical oculars magnifying 40 and 120 times; sun glass. . . . . 600

Nos	Francs.
2730. <b>Telescope, 81 millim. aperture,</b> mounted especially for the study of the heavens. The instrument is placed on a table ( <i>fig.</i> ) . . . . .	550



2730.

2740. <b>Telescope, 95 millim. aperture.</b> Same design as n <sup>o</sup> 2720 ; provided with a searcher . . . . .	900
2750. <b>Telescope, 108 millim. aperture.</b> Mounted on an oak tripod ; variable height ; general construction very solid ; two terrestrial oculars, magnifying from 60 to 90 times and three astronomical oculars, magnifying from 50 to 200 times ; sun glass . . . . .	1100

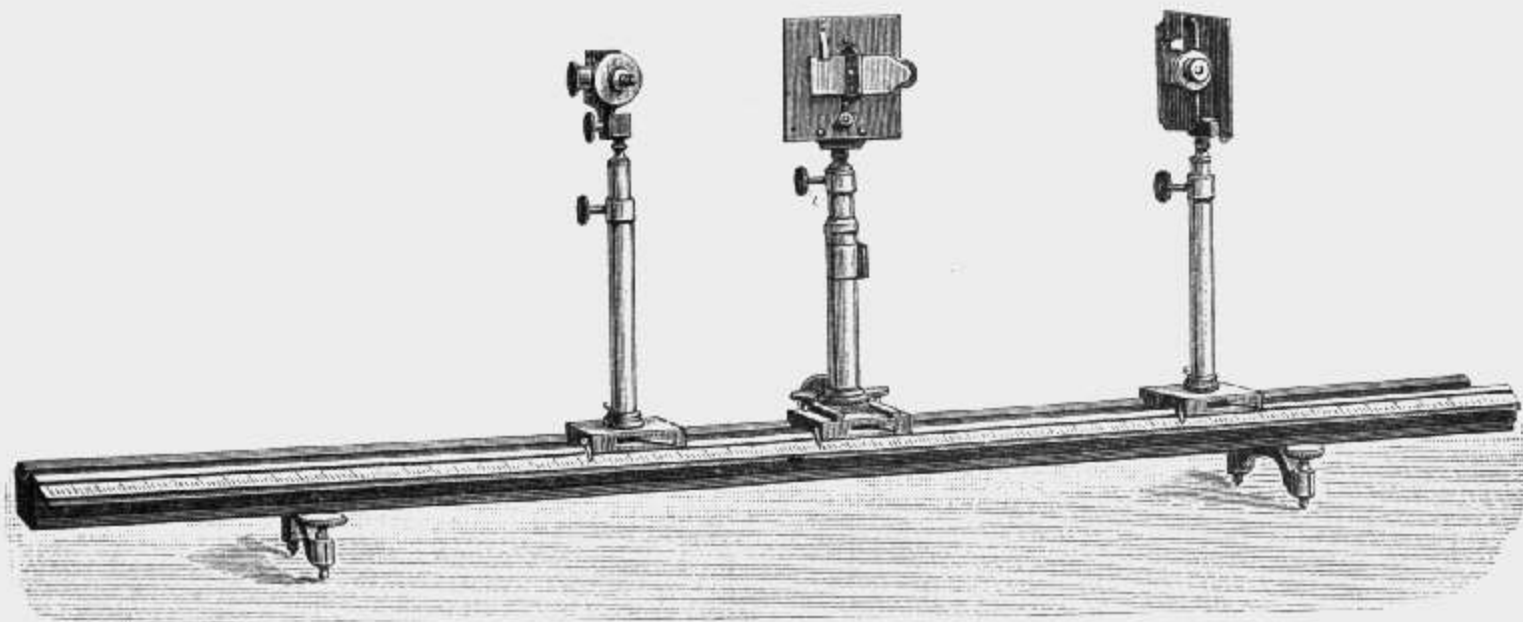
Nos

Francs.

- Telescopes** of larger dimensions, on demand.
2790. **Ramsden's Dynameter**, for measuring the power of telescopes . . . . . 18

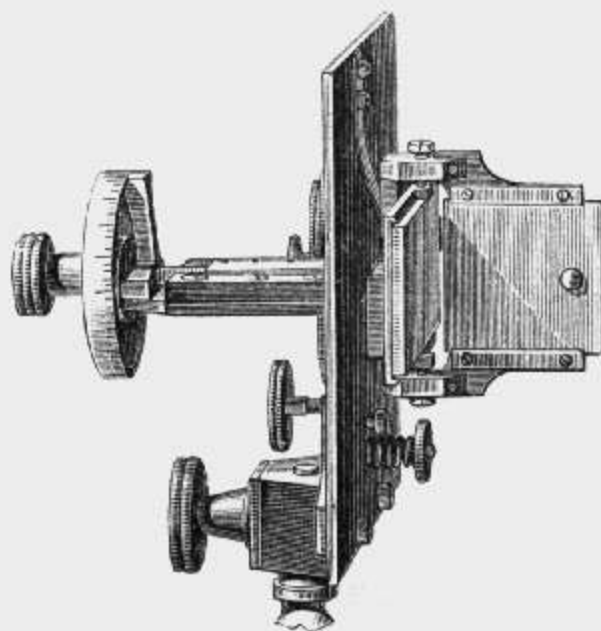
### § 28. Interference and Polarization.

2800. **General Apparatus for interferences and diffraction**, or diffraction bench, including nos 2810, 2815 and 2820 and the series of usual accessories (screens, gratings, lenses, bi-prism, &c.) (*fig.*) . . . . . 700



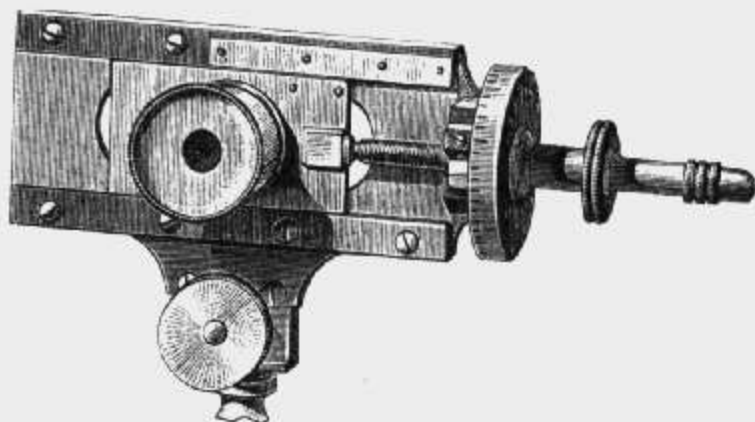
2800.

2810. **Bi-Prism**, mounted, on an adjustable stand, for producing interference bands. . . . . 40

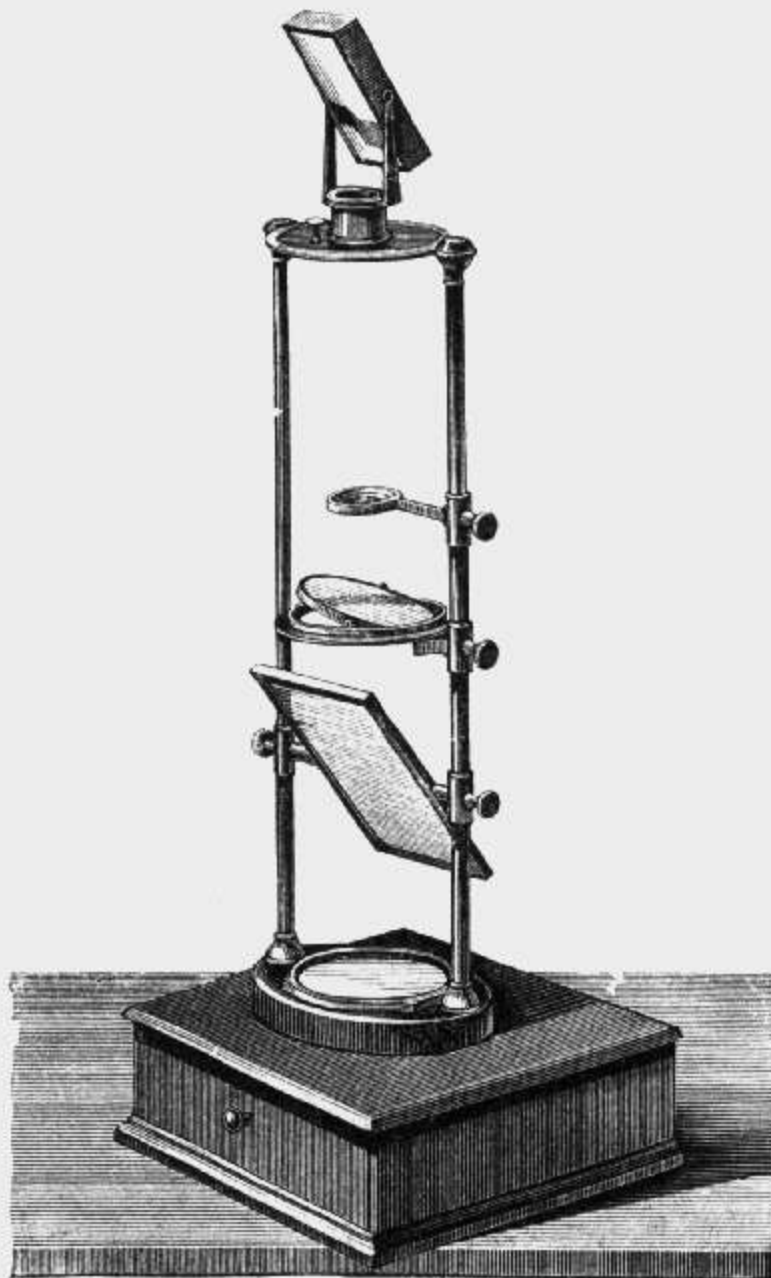


2815.

Nos	Francs.
2815. <b>Fresnel's Mirror</b> , mounted on a stand, with micrometer movement and drum divided on silver for Fizeau's experiments ( <i>fig.</i> )	150
2820. <b>Fresnel's Ocular Micrometer</b> , mounted on a stand for measuring interference bands ( <i>fig.</i> ) . . . . .	120

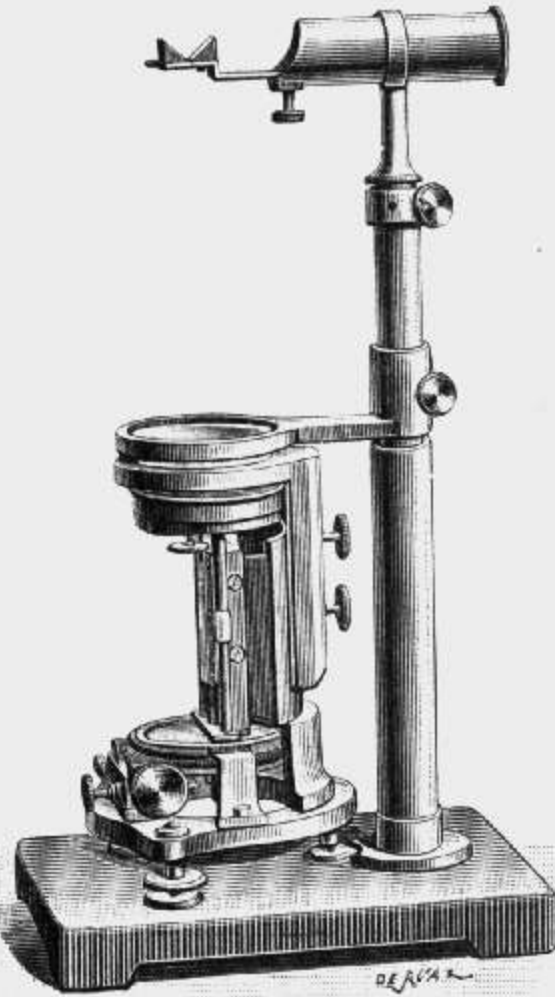


2820.



2850.

Nos	Francs.
2825. <b>Fresnel's Mirror</b> , without micrometer movement . . .	100
2830. <b>Billet's Lens</b> , mounted on a stand . . . . .	120
2835. <b>Two rectilinear Gratings</b> divided on glass into $\frac{1}{50}$ millim., superposed to produce spectra of gratings in squares 20 to 50	
2840. <b>Soret's Grating Telescope.</b> (See <i>Arch. des Sciences phys. et nat.</i> , 1895, t. LII, p 320.) . . . . .	40
2844. <b>Do.</b> mounted on a brass tripod . . . . .	70
2845. <b>Apparatus for producing Newton's rings</b> . . . . .	25
2850. <b>Norremberg's Polarization Apparatus</b> ( <i>fig.</i> ) . . . . .	125
2855. <b>Desains' Apparatus</b> for measuring wave-lengths by Newton's rings ( <i>fig.</i> ). <i>Journal de Physique</i> , III, 1874 . . . . .	300

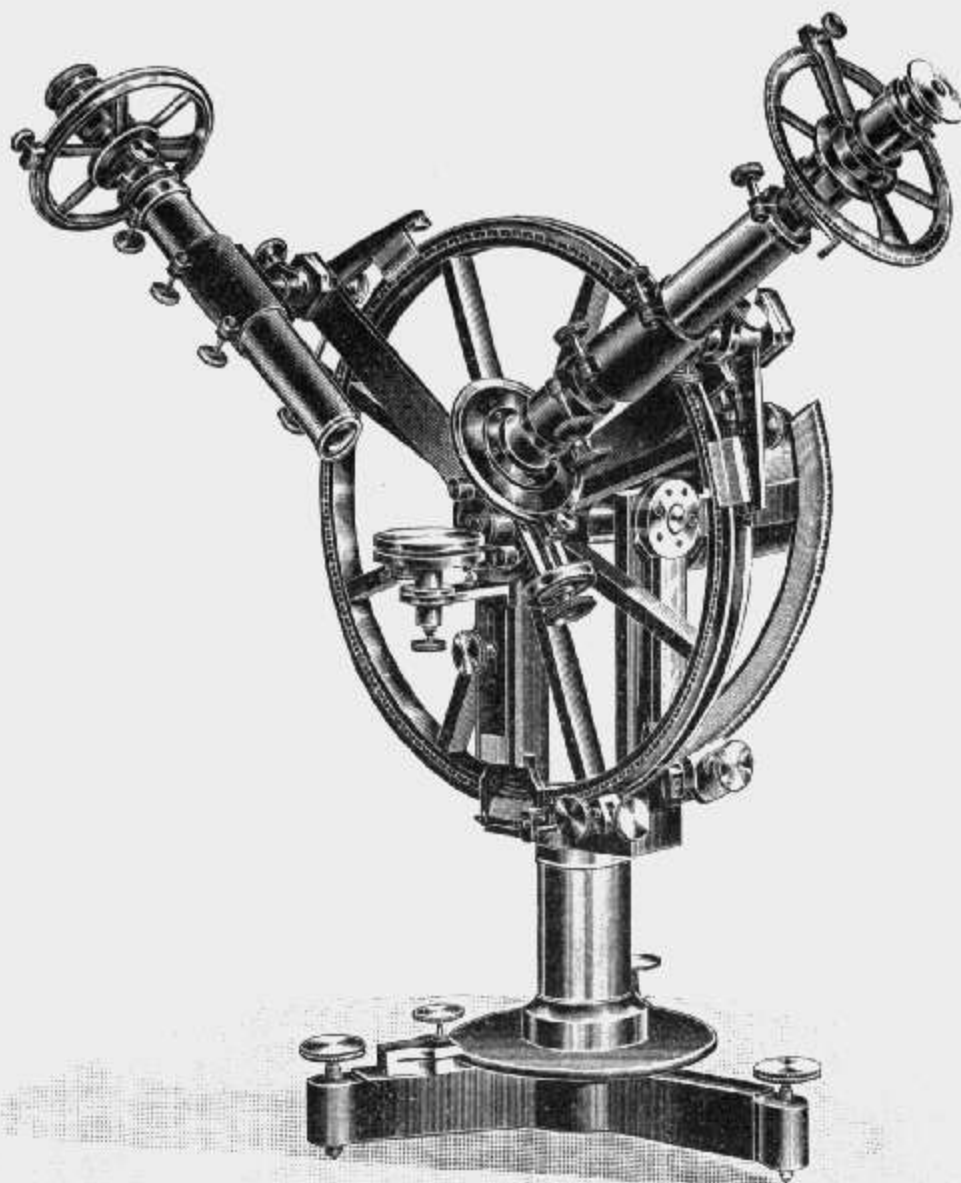


2855.

2860. <b>Babinet's Compensator</b> ; two parallel quartz prisms with crossed axes, mounted with micrometer-screw and divided head . . . . .	90
2865. <b>Pliers for Tourmaline</b> . . . . .	15 to 50



Nos	Francs.
2870. <b>Jamin's Circle</b> for repeating all experiments of reflection, refraction and polarization such as described in the <i>Cours de physique de Jamin</i> : solid construction ( <i>fig.</i> ) . . . . .	1000



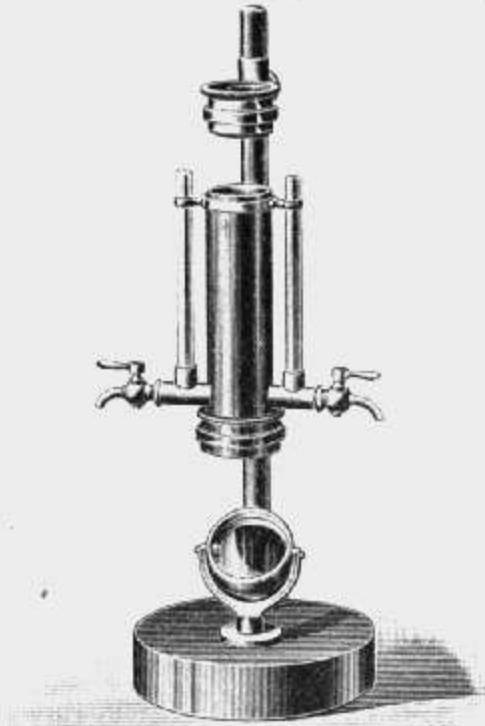
2870.

2875. <b>Zane's Colorimeter</b> ( <i>fig.</i> ) . . . . .	65
2880. <b>Do.</b> with addition of a small pocket spectroscope. . . . .	90
2885. <b>Saccharimeter.</b> Takes place of the general polarization apparatus. Circle 14 centim. in diameter, divided into $\frac{1}{3}$ degrees; vernier reading to $30''$ . Two tubes for liquids, one 100 millim. long, the other 200 millim. The apparatus is pivoted on a vertical axis. The vertical arms are long enough to allow various apparatus being interposed between the two	

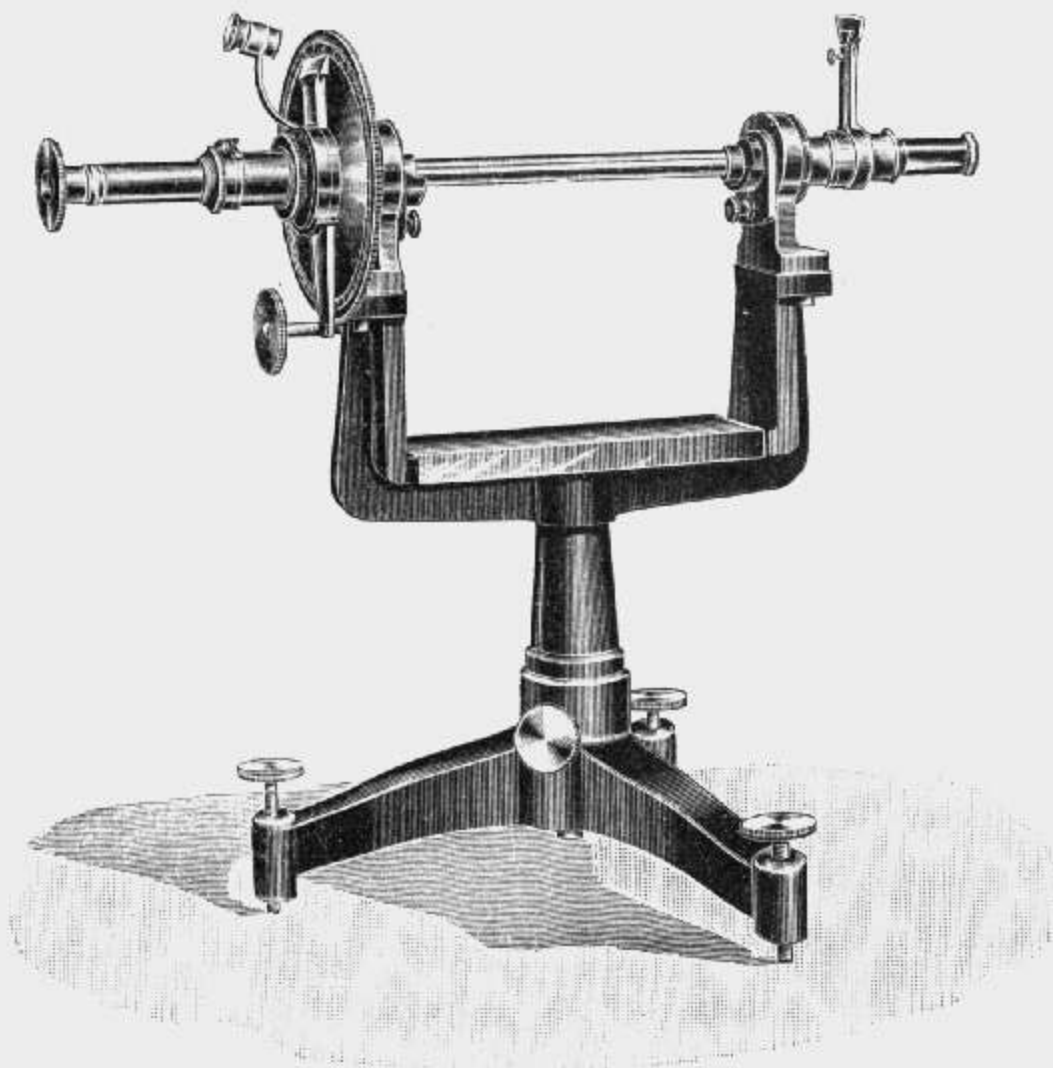
Nos

Francs.

Nicol's prisms. The small telescope, the yellow glass and Laurent's slip can slide and be easily taken off. (*fig.*) . . . . . 325



2875.

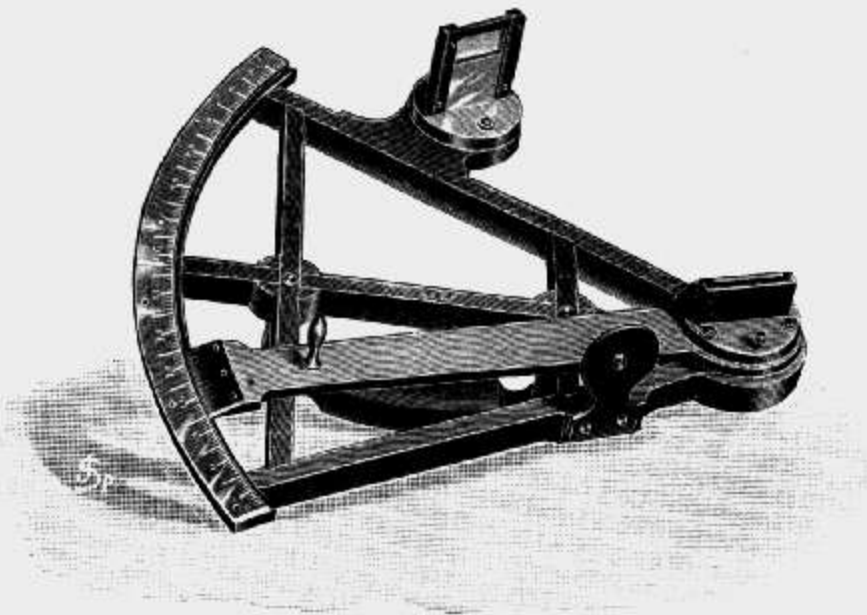


2885.

### § 29. Various Apparatus.

(for projection, photography, phosphorescence, &c.)

2900.	<b>Projection Lantern</b> , large size. Contrivance for receiving an alum trough, a photograph on glass and a projecting apparatus; adjustable stand for the electric lamp. Without electric lamp . . . . .	350
2901.	<b>Adjunction</b> of the electric lamp, n <sup>o</sup> 3870 . . . . .	140
2905.	<b>Apparatus for projecting</b> photographic negatives . . . . .	160
2910.	<b>Diaphragm with holes</b> of different sizes . . . . .	15
2915.	<b>Diaphragm with longitudinal slit</b> and adjusting screw to regulate width of slit . . . . .	30
2920.	<b>Slit Diaphragm</b> . The slit may also be regulated lengthways . . . . .	40
2925.	<b>Diaphragm with two slits</b> , which can be separated and will for the superposition of two spectra produced by a single source of light. . . . .	50
2950.	<b>Model of Sextant</b> , in wood ( <i>fig.</i> ) . . . . .	35



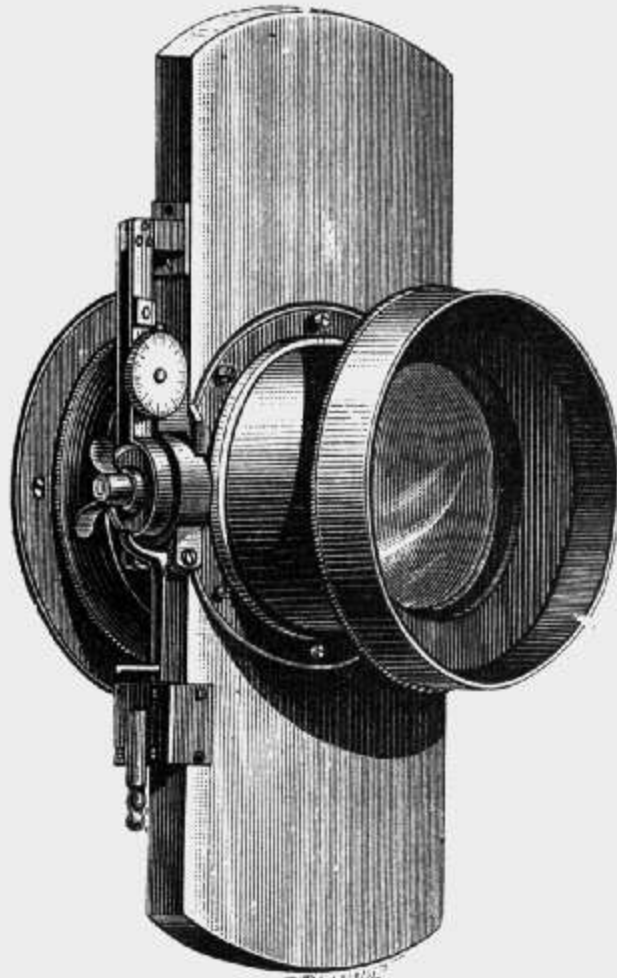
2950.

2955.	<b>Apparatus with seven mirrors</b> for the recomposition of light . . . . .	85
2960.	<b>Newton's revolving Disc</b> for the synthesis of white light . . . . .	40
	<b>Thury and Amey's Obturator</b> for instantaneous photographs. This instrument placed between the two lenses of the objective, is composed of two metallic shutters or slides, with	

Nos

Frans.

a circular aperture, and running in opposite directions. The opening and shutting of the objective thus begins in the centre. Disconnected pneumatically. Maximum of speed for average dimensions,  $\frac{1}{200}$  of a second. Controller to increase the time of exposure to one second (*fig.*).



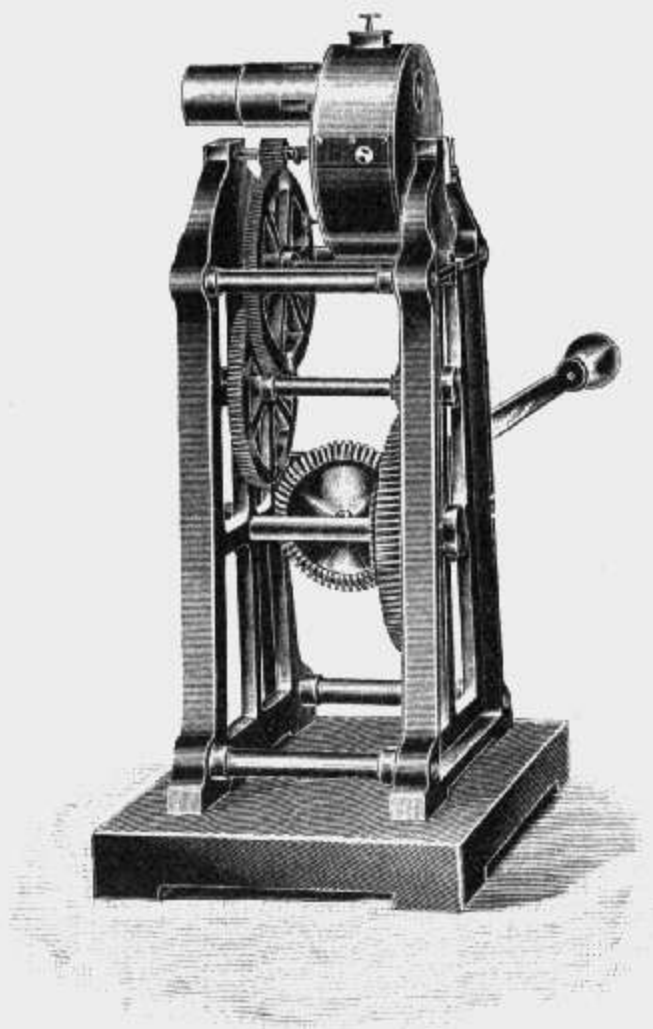
2965.

Price according to the size of the largest diaphragm used :

			With slide and set of five diaphragms in addition	
			Fr.	
2965.	N <sup>o</sup> I up to 20 millim. . . . .	Fr.	88	6.—
2966.	N <sup>o</sup> II » 30 » . . . . .	»	93	6.—
2967.	N <sup>o</sup> III » 40 » . . . . .	»	100	7.50
2968.	N <sup>o</sup> IV » 50 » . . . . .	»	110	9.—
2969.	N <sup>o</sup> V » 60 » . . . . .	»	130	11.—
2970.	N <sup>o</sup> VI » 90 » . . . . .	»	160	15.—

N<sup>os</sup> I to V are also constructed of aluminium with an increase of price from 6 to 12 fr. according to the model.

Nos		Francs.
2975.	<b>Becquerel's Phosphoroscope</b> large model mounted on a cast iron framing with cog-wheels ( <i>fig.</i> ) . . . . .	400
2980.	<b>Do.</b> small size, adjustable to n <sup>o</sup> 2900 . . . . .	120



2975.

2985.	<b>Cyclostat.</b> Apparatus for observing, as though it were at rest, a body revolving round a fixed axis. (See <i>Archives des Sciences physiques et naturelles</i> , February 1886) . . . . .	130
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## CHAPTER 3

## MAGNETISM AND ELECTRICITY

- § 30. Magnetism.  
 31. Various electrostatic apparatus.  
 32. Condensers.  
 33. Electrostatic machines.  
 34. Electrostatic measures.  
 35. Various batteries.  
 36. Electrochemical and electrodynamic measures.  
 37. Reciprocal actions of currents and magnets.  
 38. Electro-magnets. Electric lighting.  
 39. Induction.

Nos		Francs.
<b>§ 30. Magnetism.</b>		
3000.	<b>Small Magnetic Bar</b> 180 millim. long, to be suspended by a thread at its centre . . . . .	10
3010.	<b>Two Magnetic Bars</b> 25 centim. long, with armatures, in a case . . . . .	20
3011.	<b>Do.</b> 40 centim. long . . . . .	40
3020.	<b>Horse-Shoe Magnet</b> , 12 centim. long, with armature . . . . .	8
3021.	<b>Do.</b> 16 centim. long . . . . .	12
3022.	<b>Do.</b> 20 centim. long . . . . .	20
3030.	<b>Coulomb's Straight Magnet</b> , two bundles, each containing 6 magnetic bars with armatures . . . . .	120
3040.	<b>Horse-Shoe Magnet</b> , composed of five plates 16 centim. long, suspension hook . . . . .	60
3041.	<b>Do.</b> composed of five plates 20 centim. long . . . . .	90

Nos		Francs.
3050.	<b>Magnetic Needle</b> , 180 millim. long, agate cup, with foot.	10
3060.	<b>Magnetic Needle</b> , mounted in a frame and suspended by a thread to show inclination . . . . .	20
3070.	<b>Do.</b> for showing inclination and declination. Azimuthal circle and column pivoted above on a tripod with three levelling screws. The needle 100 millim. long is mounted in a circle pivoting on a horizontal axis . . . . .	90
	<b>Mariner's Compasses</b> (see <i>Geodesy</i> chap. 1 and <i>Meteorology</i> , chap. 6).	
	<b>Faraday's Apparatus</b> , see n <sup>o</sup> 3800.	

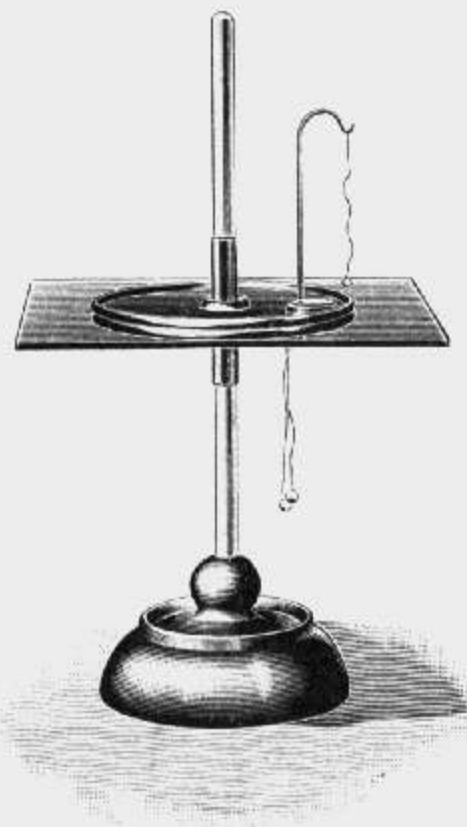
### § 31. Various Electrostatic Apparatus.

3100.	<b>Electrophore</b> , hardened rubber and tin foiled wood, insulated handle, with catskin, plate 30 centim. in diameter . . .	25
3101.	<b>Do.</b> with plate 40 centim. in diameter . . . . .	35
3105.	<b>Electroscope of straw</b> or gold leaf . . . . .	12 to 25
3110.	<b>Electric Conductor</b> , cylinder 30 centim. long, and 10 centim. in diameter, mounted on an insulated glass foot and terminated by two hemispheres, for demonstrating the distribution of electricity. . . . .	30
3115.	<b>Sphere</b> 120 millim. in diameter mounted on an insulated foot	20
3120.	<b>Insulated hollow Sphere</b> on stand, with a hole, for showing that free electricity is found only on the outer surface of bodies . . . . .	20
3125.	<b>Riess's Apparatus</b> , for the fundamental experiment of the distribution of the two electricities on a cylindrical conductor.	40
3130.	<b>Insulating Stool</b> , 50 centim. side length. . . . .	20
3135.	<b>Hail Apparatus</b> . . . . .	25
3140.	<b>Electric Chimes</b> . . . . .	25
3145.	<b>Spark Tube</b> . . . . .	18
3150.	<b>Electric Swivel</b> . . . . .	6
3155.	<b>Exciter with hinge</b> and glass handle, opening 40 centim.	18
3156.	<b>Do.</b> opening 55 centim. . . . .	25

Nos		Francs.
3160.	<b>Universal Exciter</b> with movable central column bearing a shelf . . . . .	35
3161.	<b>Do.</b> shelf provided with a slide-block for measuring explosive distance . . . . .	60
3165.	<b>Glass-Piercer</b> , small model . . . . .	20
3166.	<b>Do.</b> larger size, for piercing, with large sparks, considerable thicknesses of glass . . . . .	60

### § 32. Condensers.

3200.	<b>Condenser</b> with electroscope and graduated scale; plates 150 millim. in diameter; copper and zinc . . . . .	36
3210.	<b>Condenser with vertical plates</b> , Kohlrausch system; the gilt plates are brought together micrometrically . . . . .	200
3220.	<b>Franklin's Plate</b> . . . . .	15
3230.	<b>Leyden Jars</b> , hook with ball. . . . .	8 and 10
3240.	<b>Apparatus with two movable metallic plates</b> separated by a glass slab, for explaining the principle of the Leyden jar and condensers ( <i>fig.</i> ) . . . . .	30



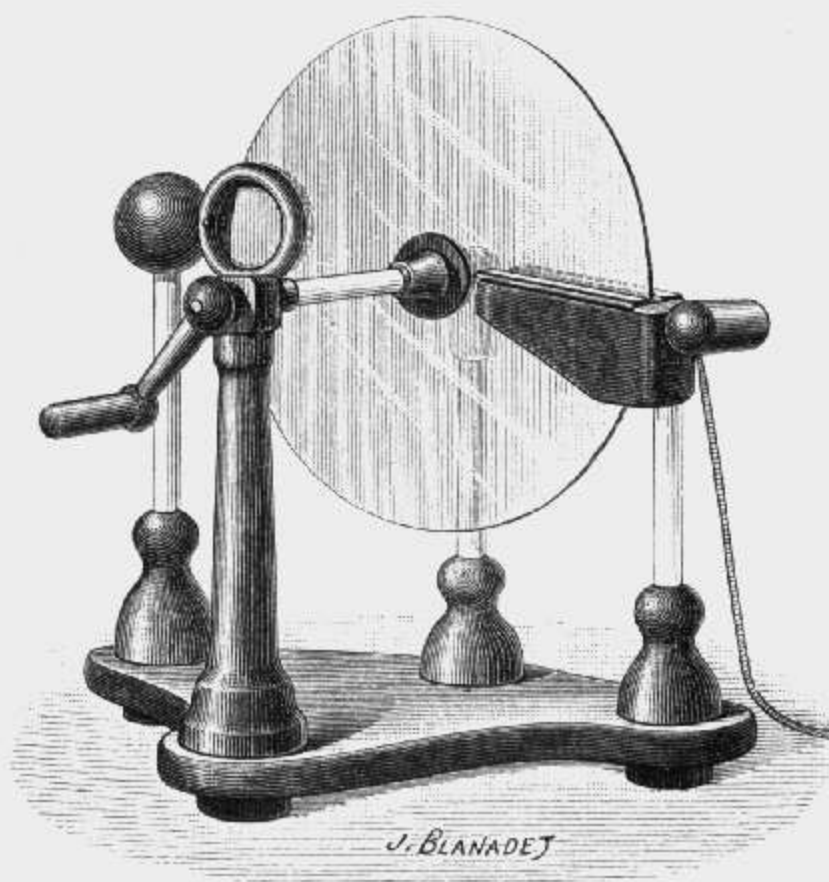
3240.

3250.	<b>Leyden Batteries</b> , with 4 jars. . . . .	50
3251.	<b>Do.</b> with 6 jars . . . . .	75



§ 33. Electrostatic Machines.

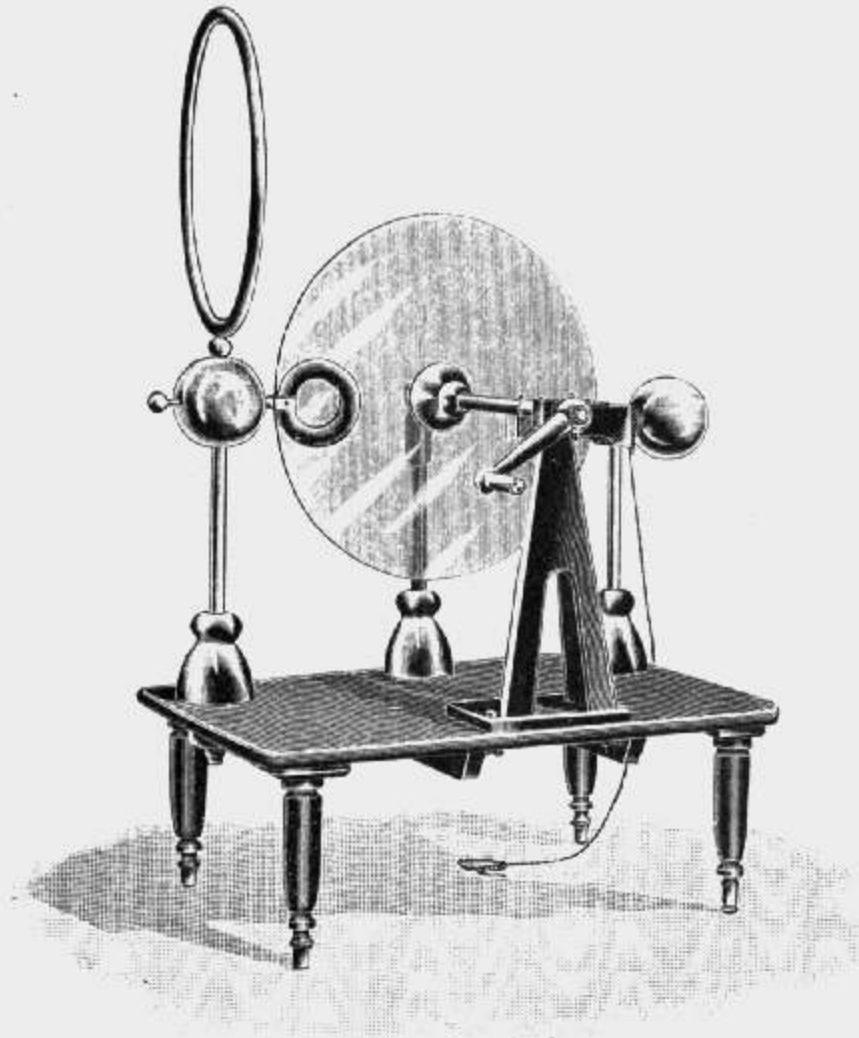
3300. **Winter's Electrostatic Machine**, for the two electricities, plate 40 centim. in diameter (*fig.*) . . . . . 120



3300.

3305.	<b>Do.</b>	with plate 50 centim. in diameter . . . . .	230
3310.	<b>Do.</b>	on table, with plate 65 centim. in diameter . . . . .	350
3315.	<b>Do.</b>	on table, with plate 80 centim. in diameter ( <i>fig.</i> ) . . . . .	550
3320.	<b>Ramsden's Electrostatic Machines</b> , same prices as above.		
3330.	<b>Holtz's Electrostatic Machine</b> , plate 55 centim. in diameter . . . . .		330
3335.	<b>Do.</b>	with two plates . . . . .	420
3340.	<b>Wimshurst's Electrostatic Machine</b> with or without sectors. Glass or ebonite plates 47 centim. in diameter. . . . .		230
3345.	<b>Do.</b>	model for physical laboratories with 4 plates of 56 centim. . . . .	600

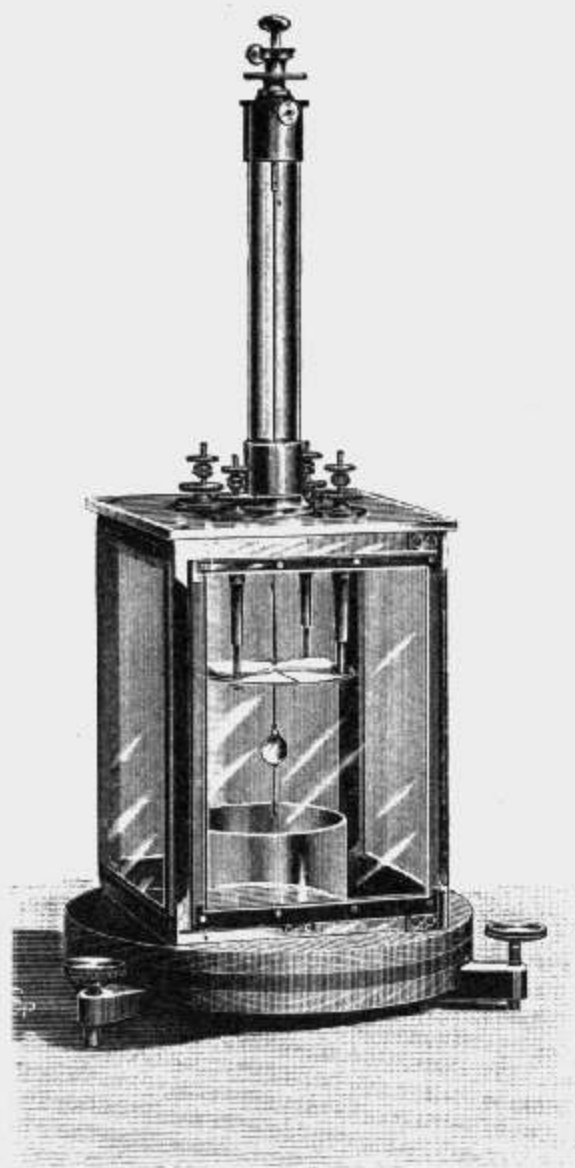
Nos	Francs.
3350. <b>Adjunction</b> of a glass case, of strong material, with exciter holder and Wimshurst's concentric insulating tubes. . . .	225



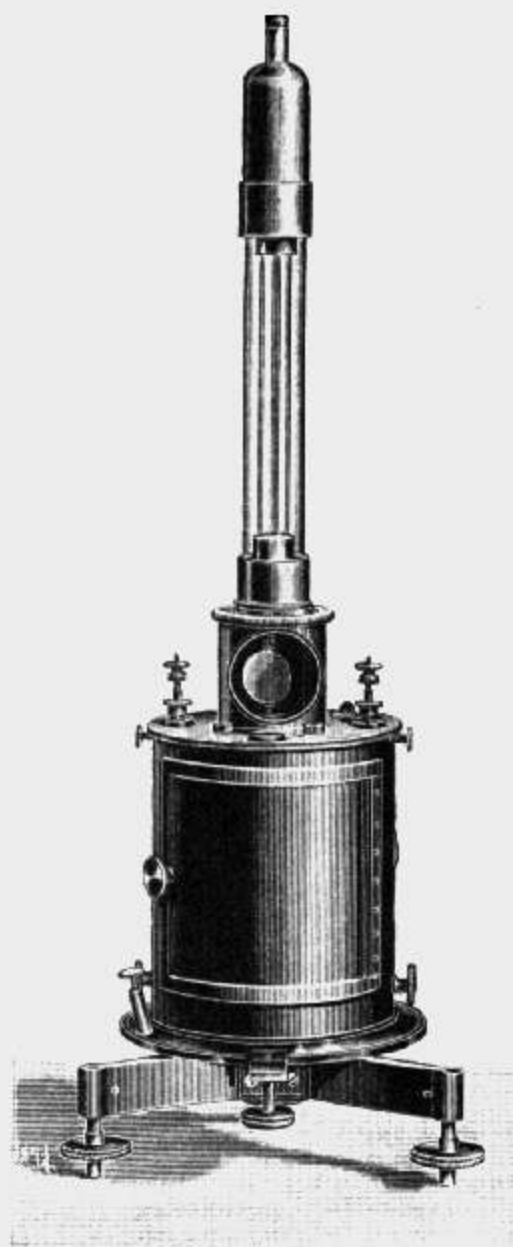
3315.

### § 34. Electrostatic Measures.

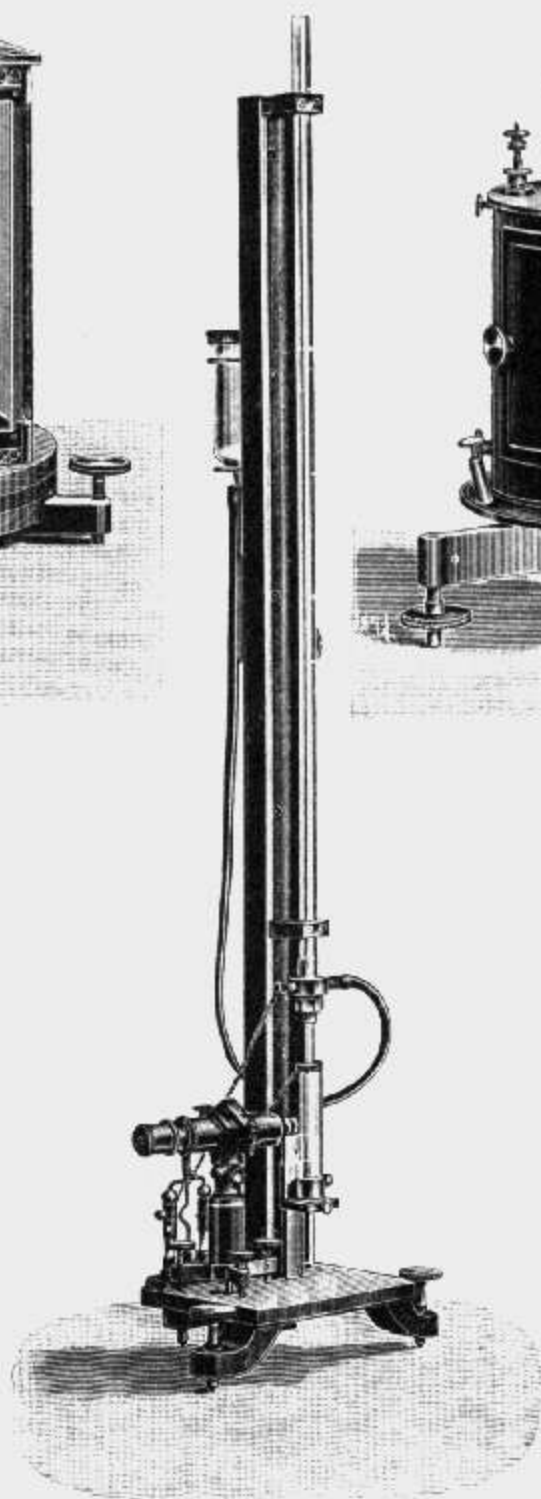
3400. <b>Coulomb's Balance</b> , with torsion wire, cylindrical model of about 25 centim. in diameter . . . . .	120
3405. <b>Do.</b> large model, square shape, 40 centim. side length. Tangent screw with micrometric drum head . . . .	320
3410. <b>Bohnenberger's Electrometer</b> with dry battery vertical model . . . . .	62
3415. <b>Do.</b> horizontal model with adjustable polar plates . . . . .	120
3420. <b>Lippmann's Electrometer</b> with microscope and manometer. Used for measuring electromotive forces from $\frac{1}{1000}$ volt to 1 volt ( <i>fig.</i> ) . . . . .	300



3435.

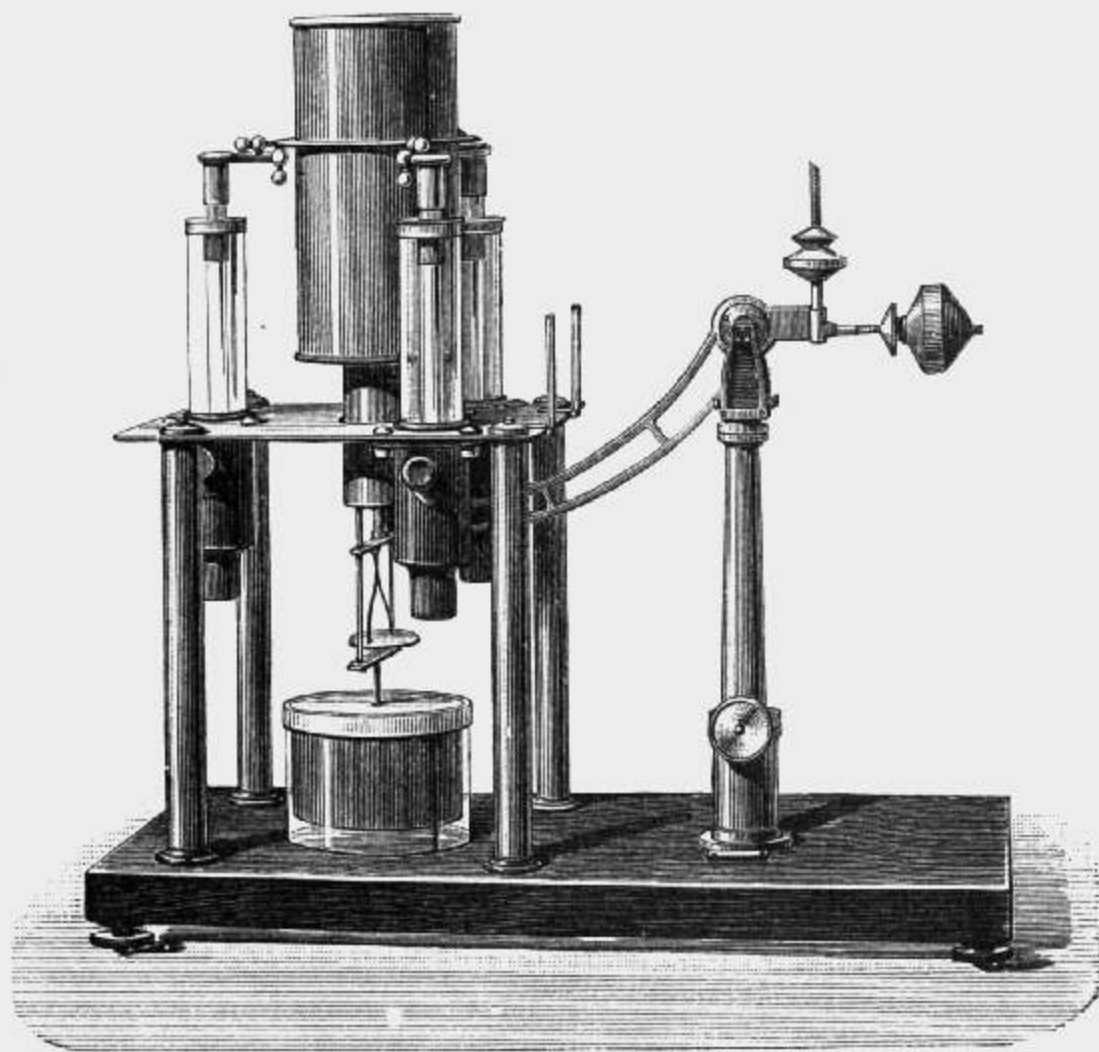


3440.



3420.

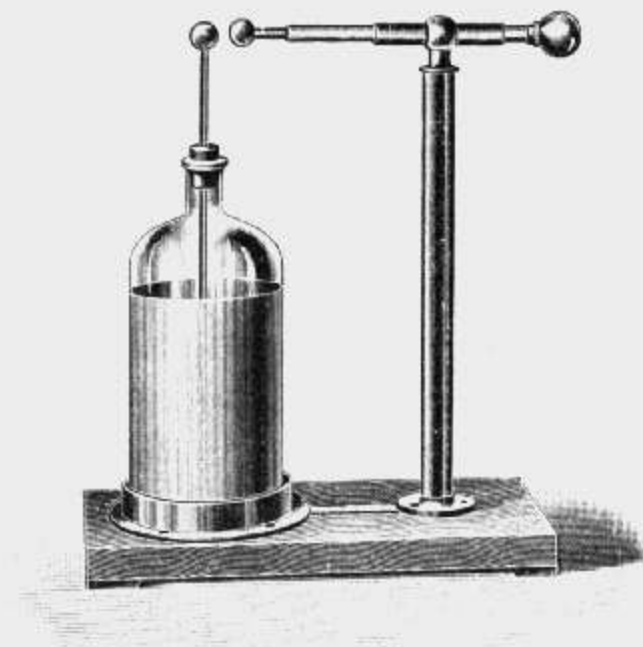
Nos	Francs.
3425. <b>De Saussure's Electrometer</b> with gold or aluminium leaves, and long pointed rod, for the study of atmospheric electricity . . . . .	80
3430. <b>Peltier's Electrometer</b> for atmospheric electricity . . . . .	120
3435. <b>Thomson's Electrometer</b> , improved by <b>Brandly</b> ( <i>fig.</i> ) . . . . .	180
3440. <b>Do.</b> improved by <b>Mascart</b> ( <i>fig.</i> ) . . . . .	250
3445. <b>Transparent Scale with mirror</b> and sliding foot. . . . .	60
3450. <b>Bichat and Blondlot's absolute Electrometer</b> , giving continuous indications. The principle of the apparatus is based on the attraction of two cylinders, one fixed, the other hanging from the extremity of a scales beam. « <i>Journal de physique</i> », 2 <sup>nd</sup> series t. V. ( <i>fig.</i> ) . . . . .	350



3450.

3451. <b>Adjunction</b> of a glass case to cover the whole apparatus . . . . .	50
3455. <b>Wet Battery</b> 50 cells, for charging electrometers . . . . .	50
3460. <b>Lane's Jar</b> , for quantitative measurements ( <i>fig.</i> ) . . . . .	50
3465. <b>Riess's Air Thermo-Electrometer</b> . . . . .	75

Nos	Francs.
3470. <b>Kinnersley's Electric Thermometer</b> , showing the expansion of gases under the influence of the electric spark . . . . .	25



3460.

### § 35. Various Batteries.

3500. <b>Nobili's thermo-electric Battery</b> composed of 25 cells, for lectures . . . . .	50
3510. <b>Do.</b> with its conic reflector for experimenting on radiating heat . . . . .	100
3520. <b>Thermo-electric linear Battery</b> with variable slit, mounted on a sliding foot . . . . .	85
3540. <b>Volta's Column Battery</b> composed of 50 copper and zinc elements . . . . .	50
3550. <b>Zamboni's Dry Battery</b> mounted in a glass tube. . . . .	30
3560. <b>Planté's secondary Couple</b> , large model . . . . .	45
<b>Various Batteries</b> (Daniell, Meidinger, Bunsen, Leclanché, &c.) supplied to order at the same price as charged by the makers.	

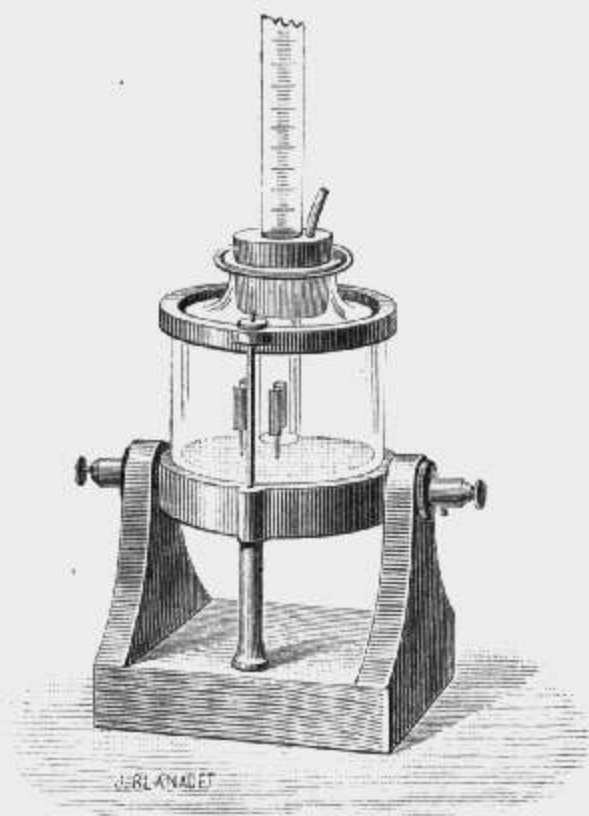
### § 36. Electro-chemical and Electro-dynamic Measures.

3600. <b>Voltmeter</b> for collecting the two gases in tubes graduated for cubic centimetres, platinum electrodes . . . . .	40
3605. <b>Do.</b> with <b>Thury's Lever</b> , for convenient and easy handling ( <i>fig.</i> ). The tube is filled with acidulated water by a simple lever movement of the upper part of the	

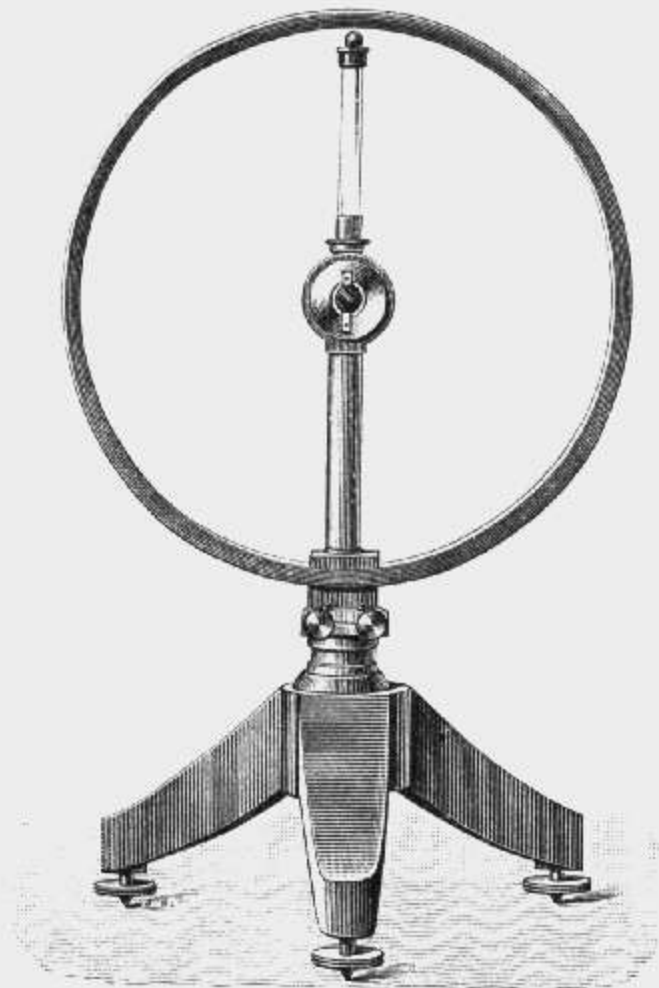
Nos

Francs.

voltmeter, without interrupting the electric connections or  
displacing or twisting the wires . . . . . 70

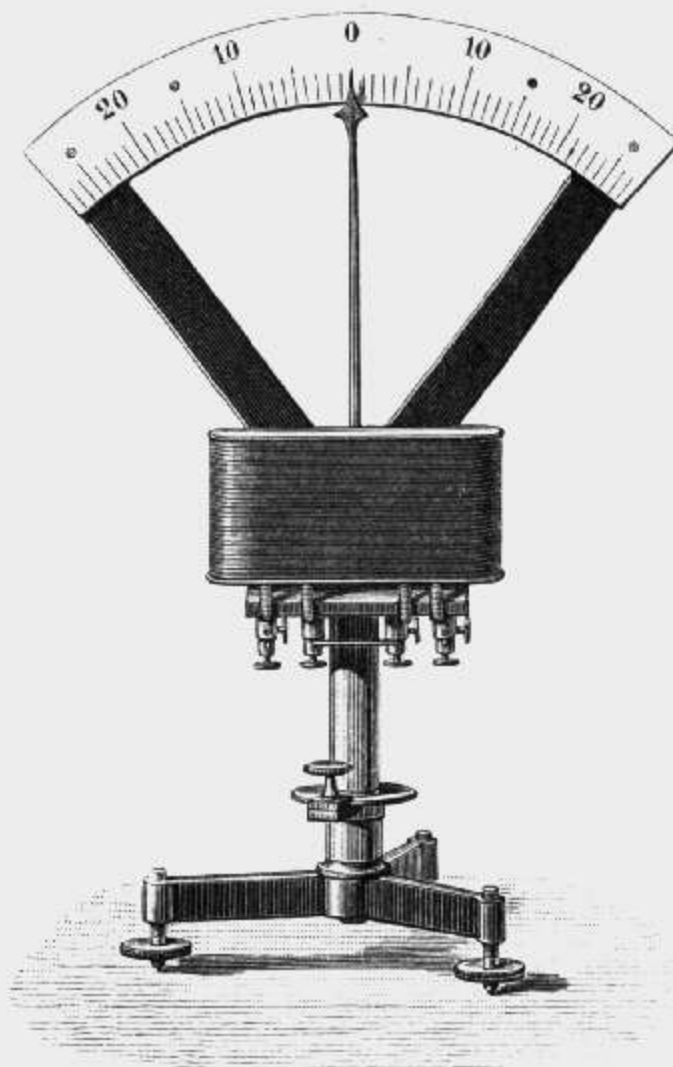


3605.



3620.

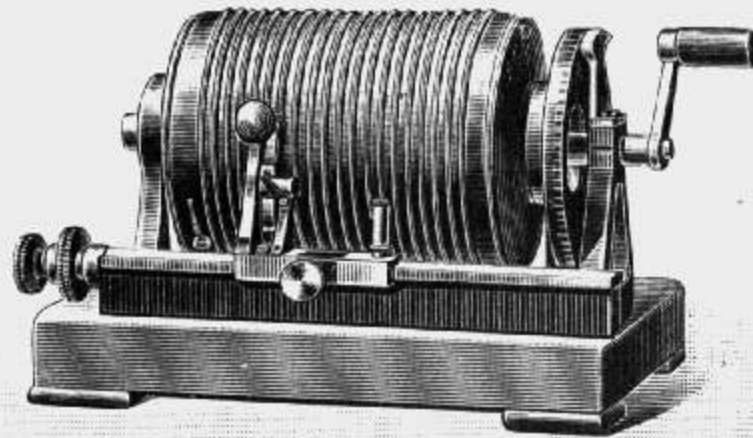
Nos		Francs.
	<b>Lippmann's Electrometer</b> (see § 34).	
3610.	<b>Tangent Galvanometer</b> with a single circle . . . . .	90
3615.	<b>Thury's differential Tangent Galvanometer</b> with three circles, whose diameters are in the ratio of 1, 2 and 3 . . . . .	75
3620.	<b>Tangent Galvanometer</b> with a single thick wire. Magne- tic steel mirror, suspended by a silken fibre in a heavy copper deadener ( <i>fig.</i> ). . . . .	170
3625.	<b>Vertical Dial Galvanometer</b> for lecture-room use ( <i>fig.</i> )	180



3625.

3630.	<b>Thomson's Galvanometer</b> with two moving coils . . . . .	400
3635.	<b>Wiedemann's Galvanometer</b> with aperiodic mirror . . . . .	300
3640.	<b>Nobili's Galvanometer</b> , heavy wire . . . . .	130
3641.	<b>Do.</b> fine wire . . . . .	160
3645.	<b>Du Bois-Raymond's Galvanometer</b> , with about 30,000 coils of very fine wire, for physiological experiments	350

Nos	Francs.
3650. <b>Rheostat with movable cursor.</b> Ebonite cylinder, about 115 millim. in diameter, graduated drum ( <i>fig</i> ) . . . . .	160



3650.

3655. <b>Wheatstone's Bridge</b> for great resistances . . . . .	45
3660. <b>Wheatstone's Rheostat</b> , small model. . . . .	120
3665. <b>Do.</b> large model with glass cylinder, 380 millim. long and 90 millim. in diameter . . . . .	450
3670. <b>Poggendorff's Rheochord</b> . . . . .	120

### § 37. Reciprocal Action of Magnets and Currents.

3700. <b>Small Apparatus for Oerstedt's experiment.</b> Deviation of the magnetic needle by a current . . . . .	30
3710. <b>Seebeck's thermo-electric Apparatus</b> , to show the deviation of the magnetic needle by a thermo-electric current . . . . .	25
3720. <b>Ampère's Apparatus</b> , with conducting wires and solenoid of aluminium, adapted for the following experiments : 1 <sup>st</sup> Like parallel currents attract each other but unlike repel. 2 <sup>d</sup> Like angular currents attract each other while unlike repel. 3 <sup>d</sup> Attraction and repulsion of the same current are equal. 4 <sup>th</sup> A sinuous current acts in like manner as a rectilinear current of the same general direction, if the extremities are identical. 5 <sup>th</sup> An intercepted current directs itself perpendicularly to the magnetic meridian. 6 <sup>th</sup> A solenoid has the essential properties of a magnet.	

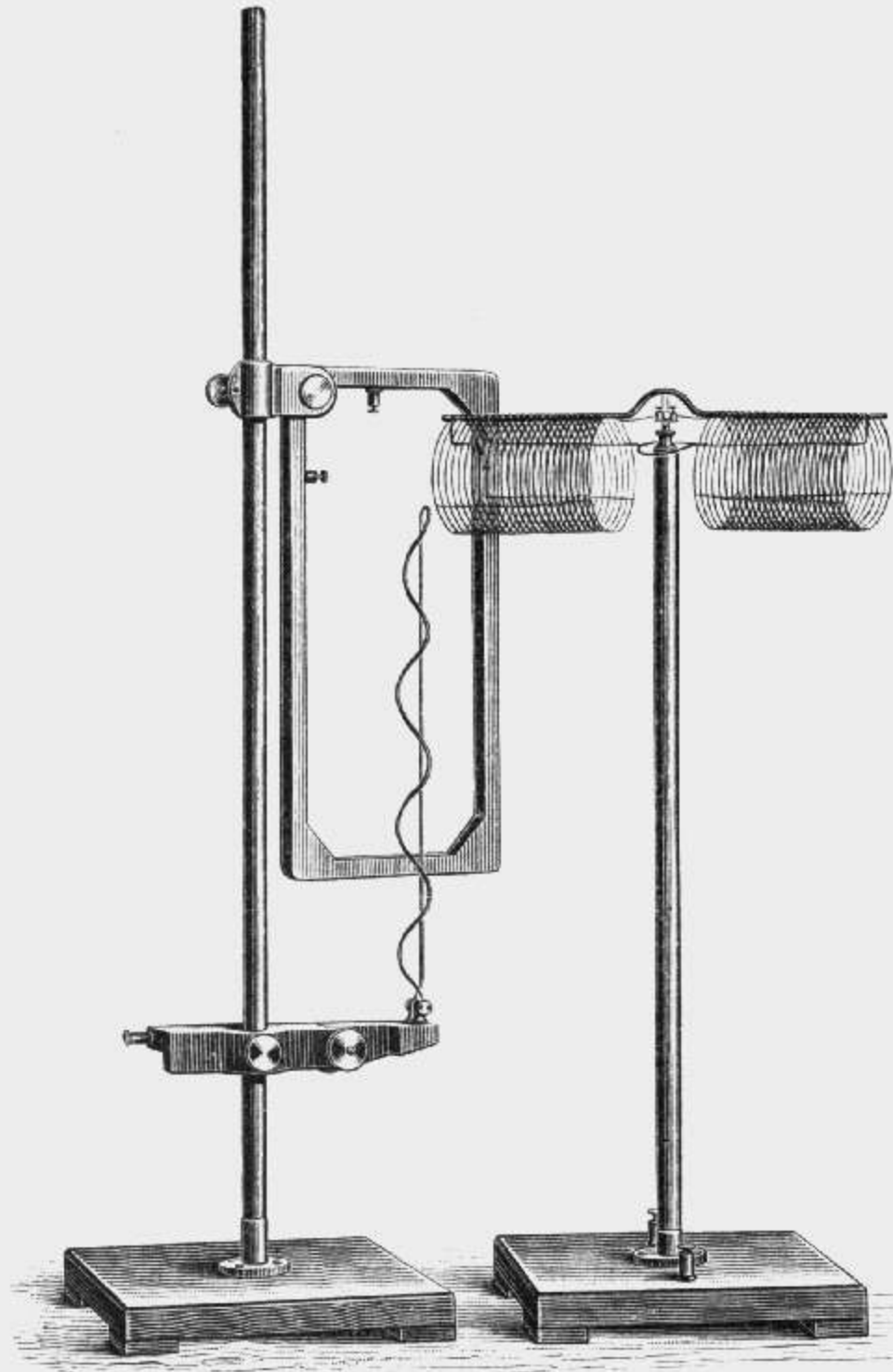


Nos

Francs.

This apparatus is so constructed that the conductor makes a complete turn and works readily with two cells of battery

(fig.) . . . . . 150



3720.

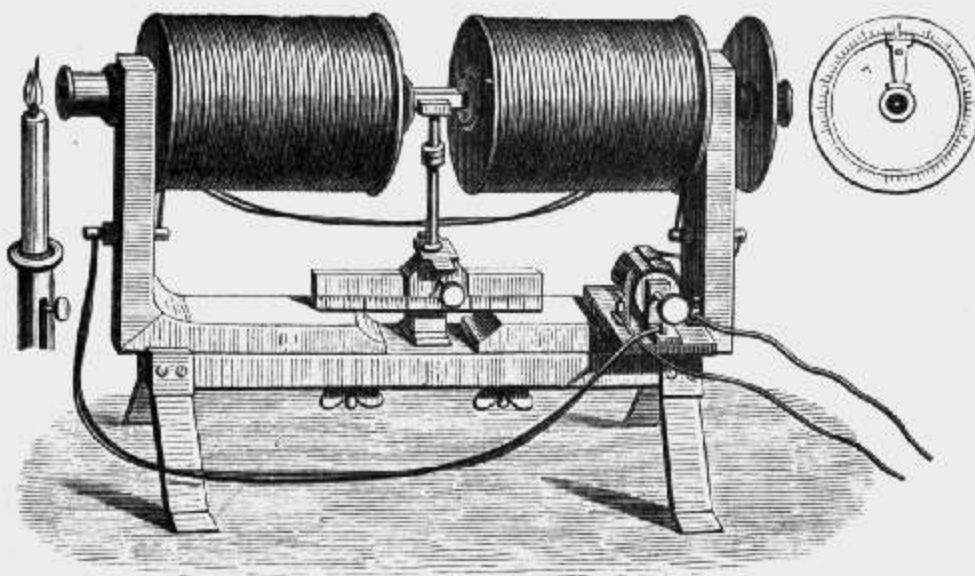
- 3730. **A Solenoid**, 35 centim. long and 80 millim. in diameter;  
wire of aluminium . . . . . 30
- 3740. **De la Rive's annular Floater** . . . . . 20
- 3745. **Roget's vibrating helix Apparatus** for showing the  
attraction of parallel currents . . . . . 50

Nos		Francs.
3750.	<b>Electro-magnetic Apparatus rotating</b> by the attraction and repulsion of a stationary electro-magnet and a moving soft iron. . . . .	60
3760.	<b>Electro-magnetic rotating apparatus</b> ; an electro-magnet turning before the poles of a stationary horse-shoe magnet . . . . .	70
3770.	<b>Electro-dynamic rotating-apparatus.</b> A moving current and a stationary magnet . . . . .	60
3771.	<b>Do.</b> a moving magnet and a stationary current	60
3772.	<b>Do.</b> a stationary current and a moving current	45
3780.	<b>Barlow's Wheel</b> . . . . .	50
3785.	<b>Rhumkorff's commutator</b> . . . . .	30
3790.	<b>Bertin's inverter</b> , ordinary model . . . . .	30
3791.	<b>Do.</b> larger model . . . . .	45

§ 38. **Electro-Magnets, Electric Lighting.**

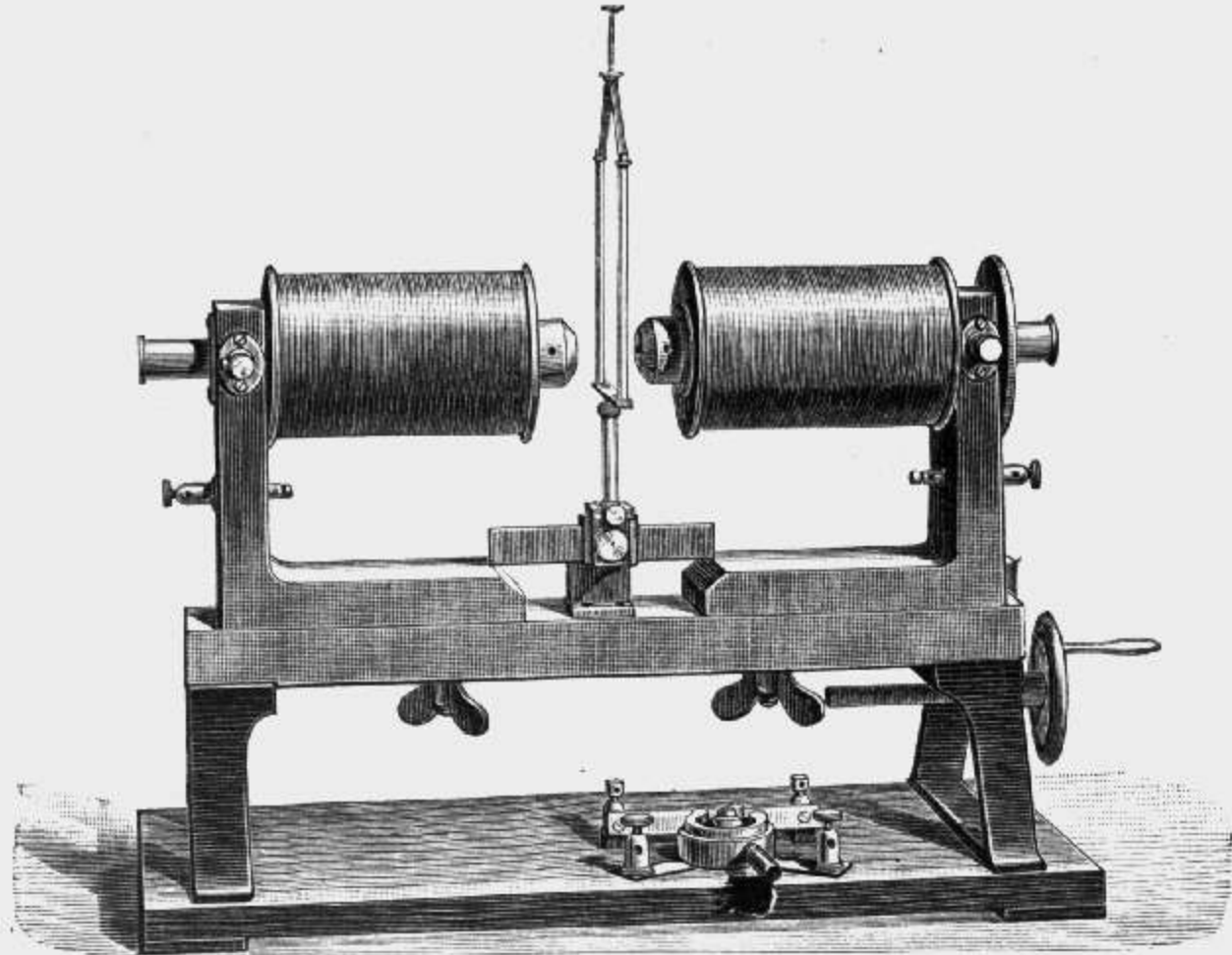
(Telegraphs, Clocks, Electric Lamps, &c.)

3800.	<b>Faraday's Apparatus</b> , for repeating the experiments on the polarization, magnetism and diamagnetism of solid and liquid bodies. Electro-magnets mounted horizontally or vertically. The reels 11 centim. in diameter and 19 centim. long ( <i>fig.</i> ) . . . . .	650
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3800.

Nos	Francs.
3810. <b>Faraday's Apparatus</b> , classical horizontal model. Reels 15 centim. in diameter and 21 centim. long. The accessories are in a box ( <i>fig.</i> ) . . . . .	850



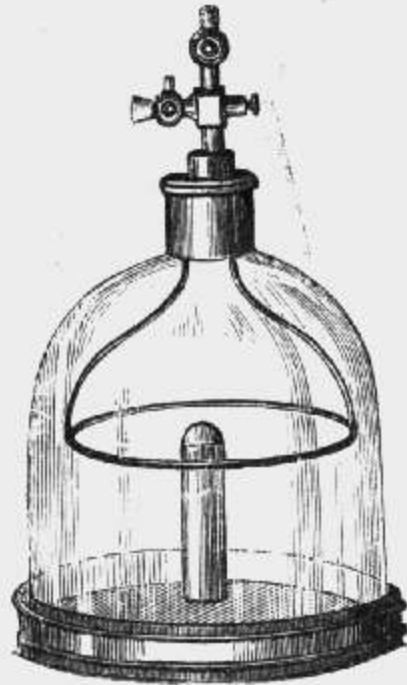
3810.

3820. <b>Do.</b> electro-magnets 17 centim. in diameter and 24 centim. long . . . . .	1400
<b>Electro-Magnets</b> , for laboratories. See <i>Applied Electricity</i> , § 97.	
3850. <b>Morse's Telegraph</b> . Lecture room model with manipulator . . . . .	180
3860. <b>Electric Clock</b> , lecture room model . . . . .	75
3870. <b>Electric Lamp</b> , vertical, for laboratories; regulated by hand by means of three racks and pinions; can be used with the projection lantern n <sup>o</sup> 2900 . . . . .	140

**§ 39. Induction.**

3900. <b>Faraday's Reels</b> . Two reels, one sliding into the other, for demonstrating the theory of induction currents . . . . .	40
3901 <b>Do.</b> of larger dimensions . . . . .	80

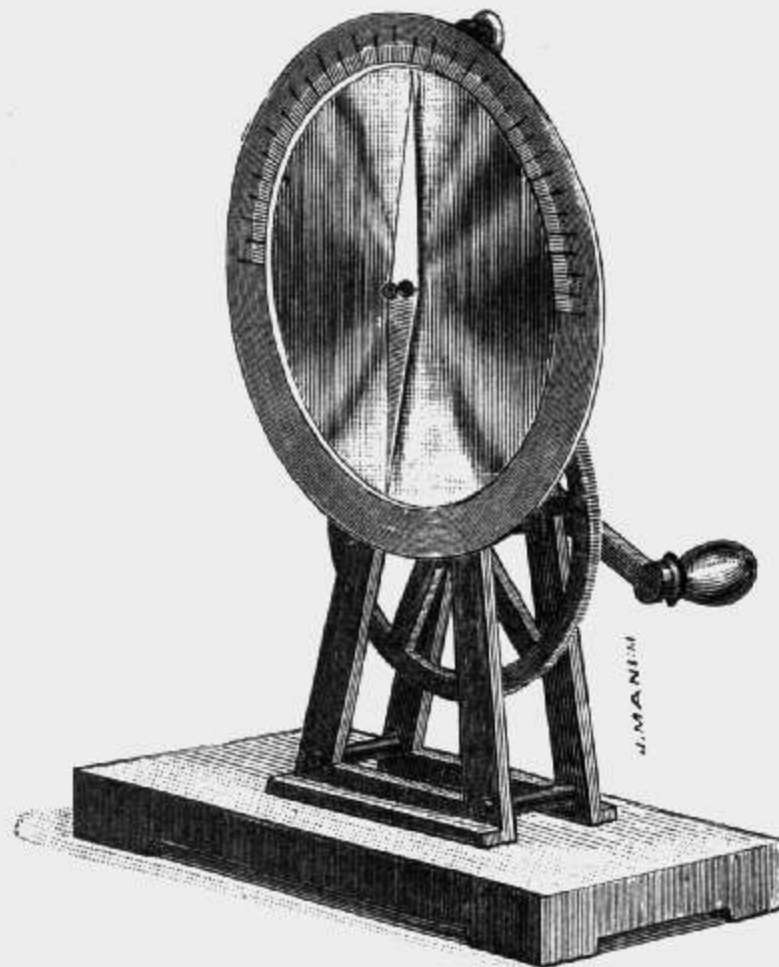
Nos	Francs.
<b>Induction Coils.</b>	
3905. Unwrapped reel, spark 5 millim. . . . .	15
3906. do. do. 10 do. . . . .	35
3907. do. do. 15 do. . . . .	60
3908. do. do. 20 do. . . . .	100
3909. Wrapped reel with trembler, spark 30 millim. . . . .	150
3910. do. do. 60 do. . . . .	300
3911. do. do. 120 do. . . . .	500
3912. Wrapped reel, spark 30 centim. . . . .	1000
3913. do. do. 35 do. . . . .	1250
3914. do. do. 40 do. . . . .	1500
3915. do. do. 45 do. . . . .	1750
3916. do. do. 50 do. . . . .	2000
3920. <b>Wheel Interrupter</b> . . . . .	20
3925. <b>Model of automatic Interrupter</b> with hammer, called : trembler . . . . .	35
3930. <b>Foucault's Interrupter</b> . . . . .	125



3950.

3935. <b>Margot's Interrupter</b> , similar to Roget's apparatus based on the self attraction of the coils of a helix. The helix is formed of a limited number of coils of thick copper wire and placed inside of a test tube . . . . .	100
3940. <b>Electric Egg</b> for a vacuum, with leather box and movable stem.	65
3945. <b>De la Rive's Electric Egg</b> , for the rotation of the voltaic arc round an electro-magnet, with Gay-Lussac's stop-cock . . . . .	170

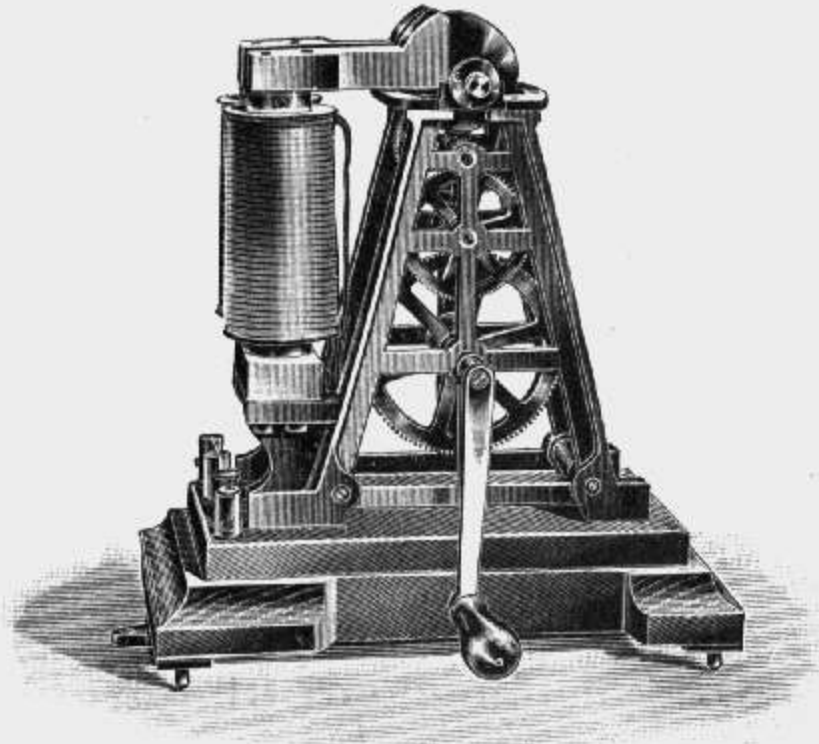
Nos		Francs.
3950.	<b>De la Rive's Apparatus</b> for the reproduction of the aurora borealis phenomenon. Recipient formed by a glass bell on a metallic stand, like those of pneumatic machines, and penetrated by a soft iron and an annular electrode. The apparatus must be placed on a straight electro-magnet ( <i>fig.</i> ) . . . . .	160
3955.	<b>Faraday's Apparatus</b> , for showing the existence of an induced current in a copper plate revolving between the poles of a magnet . . . . .	75



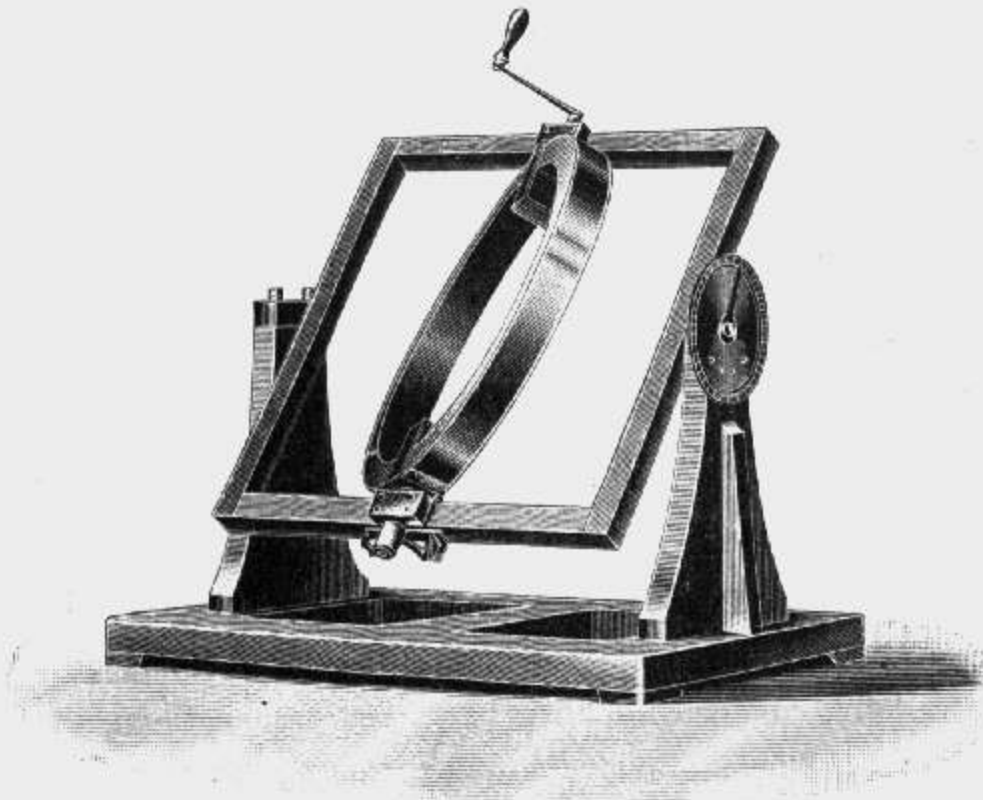
3965.

3960.	<b>Arago's Apparatus</b> for showing the rotation of a magnetic needle under the influence of a revolving copper plate . . .	
3965.	<b>Do.</b> for the lecture-room. The needle turns in a vertical plane; the apparatus is supplied with several plates ( <i>fig.</i> ). . . . .	180
3970.	<b>Fesseland Plücker's Apparatus</b> for unipolar induction. . . . .	150
3975.	<b>Foucault's Apparatus</b> , for the correlation of heat, electricity and mechanical force ( <i>fig.</i> ) . . . . .	400
3980.	<b>Do.</b> small model for the lecture room. The rotary motion of the copper disc is produced by the falling of a weight. . . . .	120

Nos	Francs.
3985. <b>Delézenne's Hoop</b> for producing induction currents under the influence of the earth. Model with wooden circle 55 centim. in diameter and commutator ( <i>fig.</i> ) . . . . .	200
3990. <b>Gramme's Machine</b> , lecture room model . . . . .	150
<b>Dynamo-Electric Machines</b> for laboratories and industrial purposes. See <i>Applied electricity</i> § 97.	



3975.



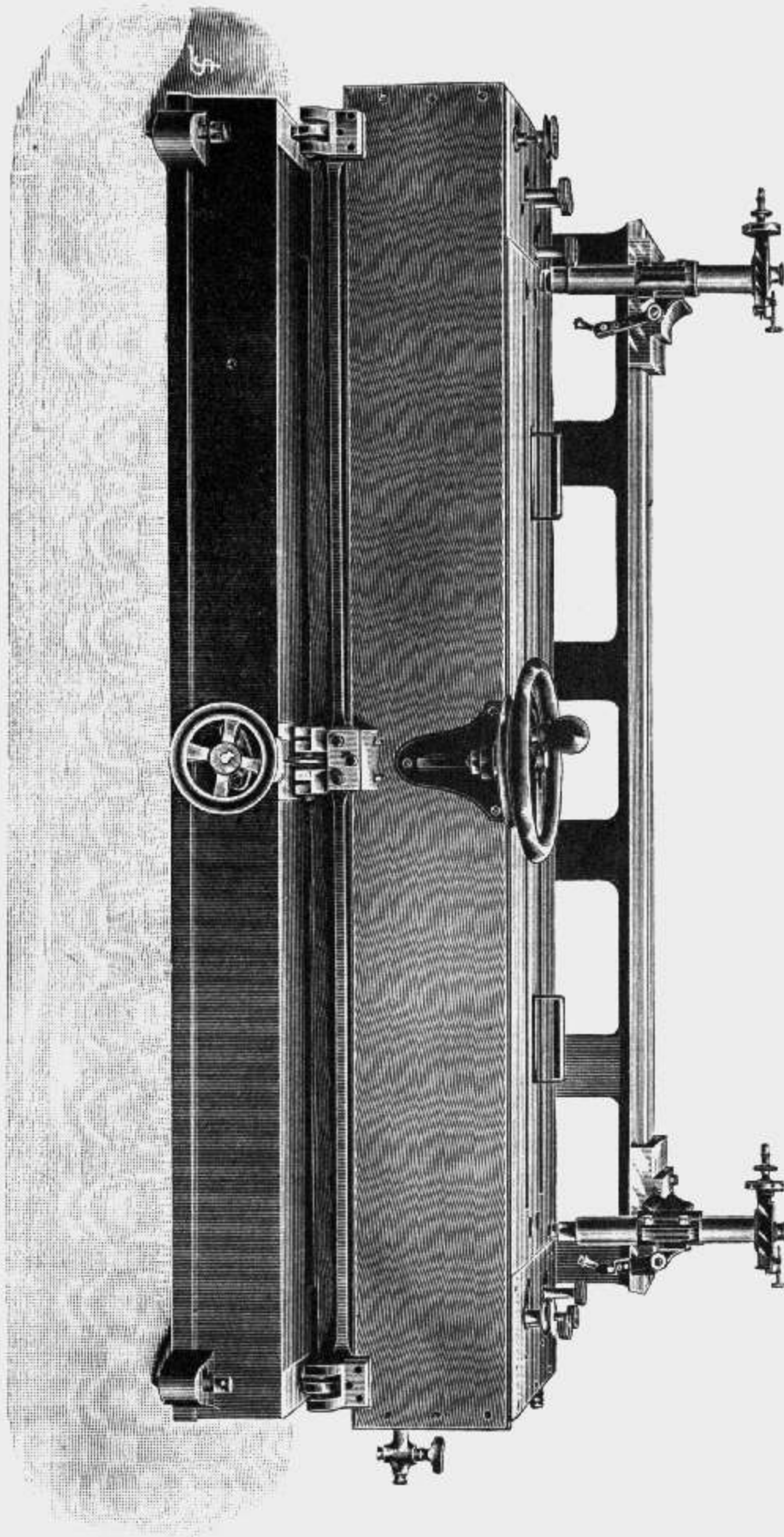
3985.

## CHAPTER 4

## HEAT

- § 40. Phenomena of Dilatation.  
 41. Measuring of Dilatations.  
 42. Thermometers.  
 43. Thermometry.  
 44. Change of state of bodies.  
 45. Specific Heat and Latent Heat.  
 46. Tension and density of vapours.  
 47. Phenomena of Calefaction.  
 48. Propagation of Heat.  
 49. Conductibility of Heat.

Nos	Francs.
<b>§ 40. Phenomena of Dilatation.</b>	
4000. <b>S'Gravesande's Ring</b> , red copper sphere . . . . .	25
4010. <b>Pyrometer</b> with dial and double lever, for showing the linear dilatation of metals . . . . .	55
4050. <b>Apparatus</b> for the demonstration of the maximum density of water; including the thermometers . . . . .	25
<b>§ 41. Measuring of Dilatations.</b>	
4100. <b>Regnault's Air Pyrometer</b> , with porcelain reservoir, without scale, arranged for observation with the cathetometer	125
4110. <b>Regnault's Air Pyrometer</b> , with millimetric scales. . .	140
4111. <b>Porcelain Reservoir</b> to above, separate. . . . .	18
4120. <b>Differential Pyrometer</b> , principally for industrial pur- poses. Two tubes, one of platinum, the other of copper, placed parallelly, connected at their base, and prolonged by copper rods; the whole provided with an iron cover. One of these rods bears at its extremity a double lever marking the difference	



4130.



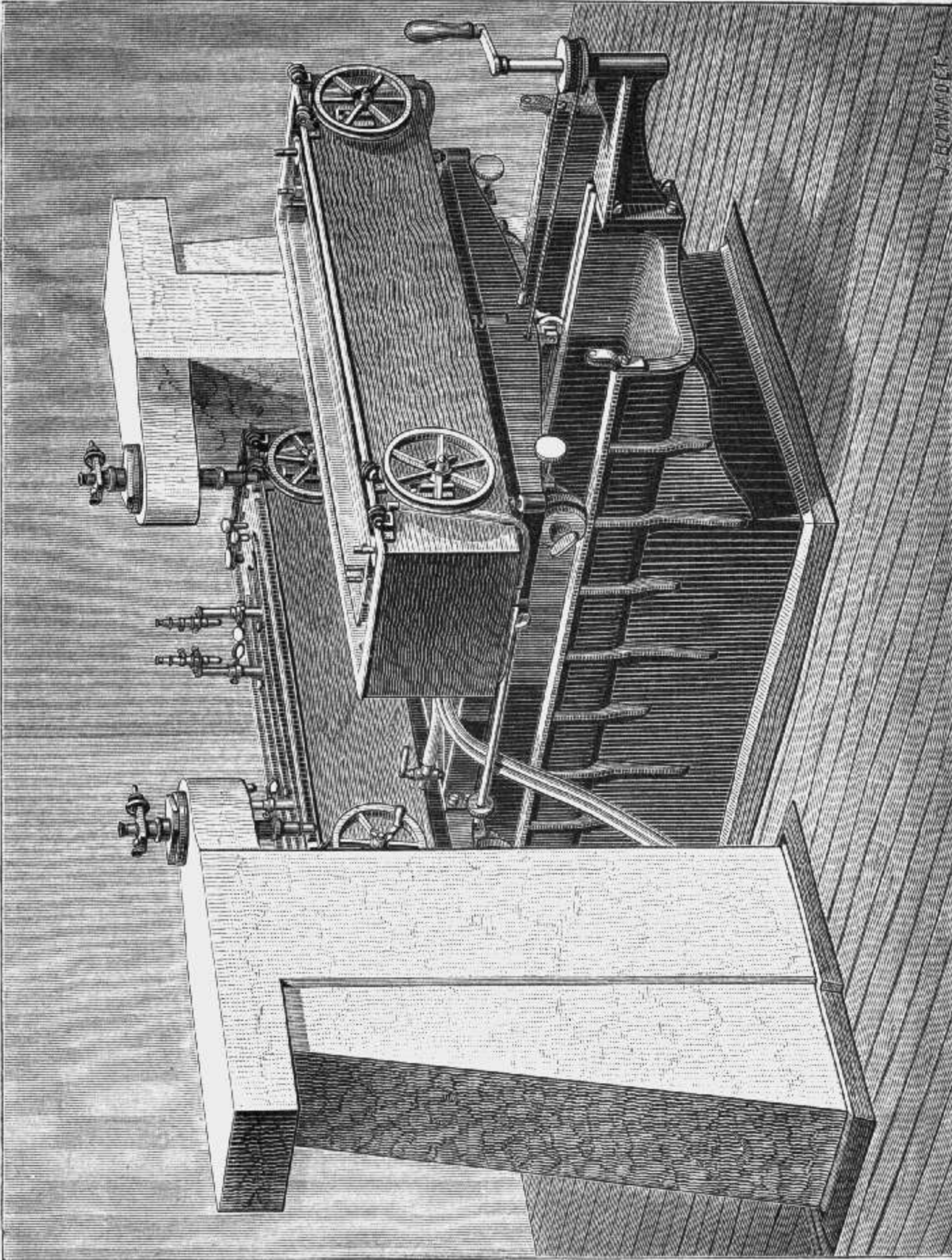
Nos	Francs
of dilatation between the two tubes. According to the differences of construction and the use of the instrument . . .	120 to 150
<b>Comparators</b> (see also <i>General Measuring Instruments</i> , chapter 0, § 02.)	
4130. <b>Comparator for determining the Coefficients of Dilatation</b> of rods up to one metre long. The apparatus is provided with two micrometer microscopes and a double bath with water circulation and regulating movement for adjusting it. Movable truck to shift the double bath ( <i>fig.</i> ) . . .	2500
4140. <b>Comparator for determining the Coefficients of Dilatation</b> of graduated rods one metre long ( <i>fig.</i> ). This apparatus was constructed for the Bureau international des Poids et Mesures. (See for the description the <i>Mémoires du Bureau international des Poids et Mesures</i> ) . . . . .	7500

**§ 42. Thermometers.**



4200. <b>Standard mercurial Thermometer</b> , with gauged scale, divided on stem into $\frac{1}{5}^{\circ}$ , from $- 0^{\circ}$ to $+ 100^{\circ}$ . . .	35
4210. <b>Mercurial Thermometer</b> , divided into $\frac{1}{5}^{\circ}$ , from $- 20^{\circ}$ to $+ 60^{\circ}$ , paper scale, glass cover . . . . .	15
4220. <b>Mercurial Thermometer</b> , divided on stem into $\frac{1}{5}^{\circ}$ , from $- 10^{\circ}$ to $+ 50^{\circ}$ . . . . .	15
4225. <b>Mercurial Thermometer</b> , divided on stem into half degrees, from $- 20^{\circ}$ to $+ 100^{\circ}$ . . . . .	15
4230. <b>Do.</b> divided on stem into degrees from $- 0^{\circ}$ to $+ 360^{\circ}$ . . . . .	25
4235. <b>Do.</b> divided on stem from $0^{\circ}$ to $+ 200^{\circ}$ . . . . .	20
4240. <b>Spirit of wine Thermometer</b> , divided on stem from $- 40^{\circ}$ to $+ 50^{\circ}$ . . . . .	12
4250. <b>Rutherford's minima Thermometer</b> , horizontal, graduated on stem . . . . .	15
4260. <b>Negretti's maxima Thermometer</b> horizontal, graduated on stem . . . . .	18

Nos		Francs.
4265.	<b>Frame</b> for holding self registering thermometers . . . . .	6
4270.	<b>Borda's metallic Thermometer</b> . . . . .	55



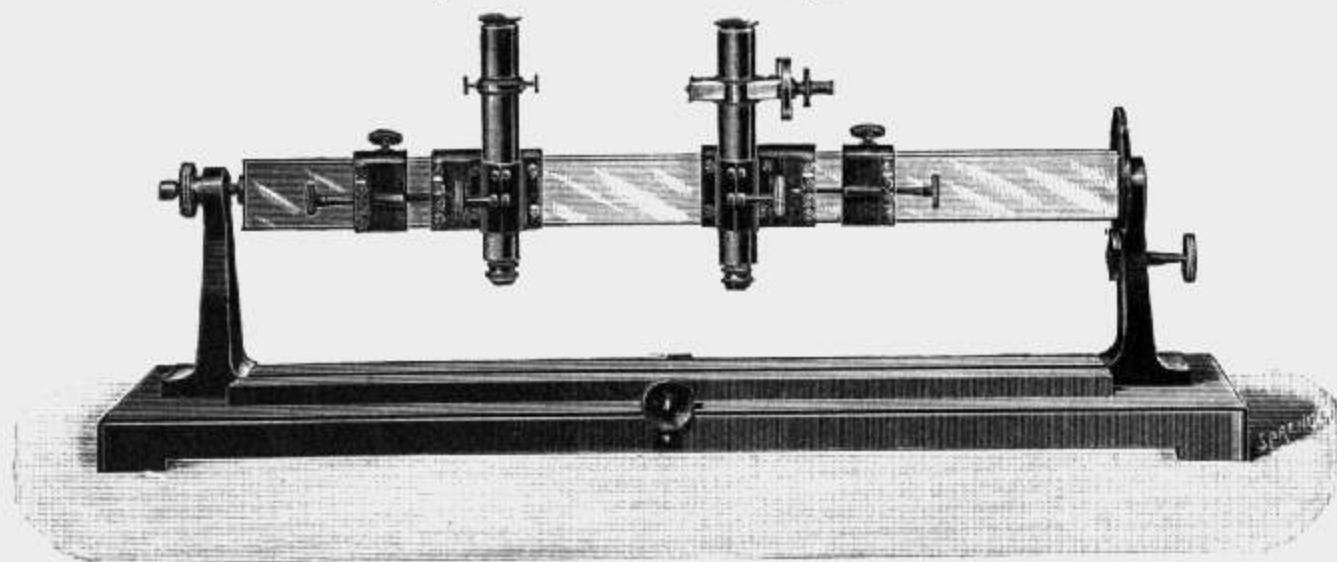
4140.

Nos

Francs.

### § 43. Thermometry.

4300. **Gauging Apparatus** for testing thermometers. The essential part of the apparatus consists of two micrometer microscopes sliding along a horizontal rule and provided with the movements required for observation (*fig.*) . . . . . 250



4300.

4310. **Recipient** in sheet brass tinned, pierced with a hole at the bottom, to determine the zero point in melting ice . . . . . 12
4320. **Regnault's Apparatus**, in sheet brass tinned, to determine the point of  $100^{\circ}$ . . . . . 35
4330. **Divided Rule** for comparing the three usual thermometer scales; about 30 centim. long . . . . . 15

### § 44. Change of State of Bodies.

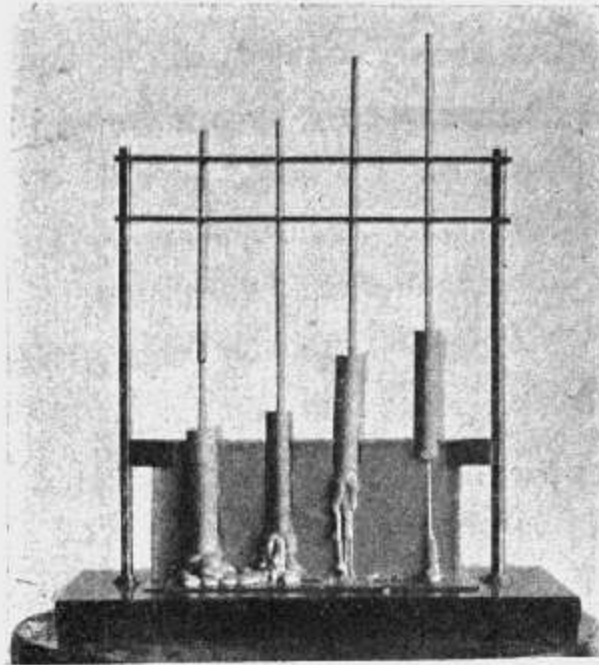
4400. **Mousson's Apparatus** for the melting of ice . . . . . 35
- Piezometers.** (See *Experimental Mechanics*, chap. 7, § 74.)
4410. **Wollaston's Cryophore** . . . . . 6
4420. **Wood or iron Mould** for moulding snow or ice under strong pressures . . . . . 6 to 40
4430. **Leslie's Apparatus**, for freezing in a vacuum . . . . . 12
4440. **Pouillet's Apparatus**, for the same experiment . . . . . 75
4450. **Regnault's Hypsometer**, see n<sup>o</sup> 6200.
4460. **Papin's Kettle**, n<sup>o</sup> 4650.

Nos

Frans.

### § 45. Specific Heat and Latent Heat.

4500. **Tyndall's Apparatus** to show the specific heat of different bodies. Spheres of different metals with cake of wax and mould for obtaining it; support for the same . . . . . 30



4505.

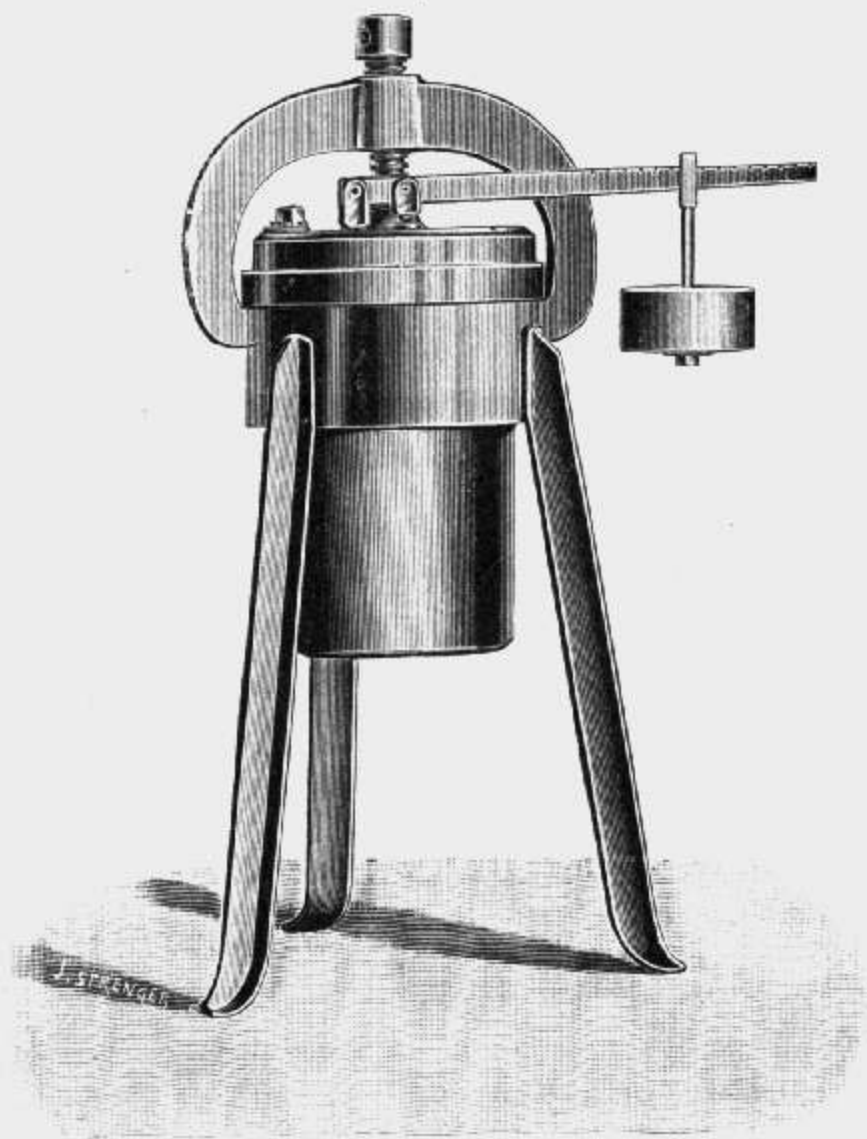
4505. **Apparatus** to show the **specific heat** of different bodies, designed by Prof. H. Schoentjes; cylinders of different metals, heated in boiling water and placed on the edge of a cake of wax. With mould for obtaining the cake (*fig.*) . . . . . 50
4510. **Dulong and Petit's Apparatus** for measuring the specific heat by cooling . . . . . 70
4520. **Regnault's Apparatus** for measuring the specific heat by the method of mixtures; model for solid bodies . . . . . 250
4525. **Regnault's Apparatus**, model for liquids . . . . . 250
4530. **Water Calorimeter** to determine the specific heat by the method of mixtures . . . . . 55
4540. **Clément and Desormes' Apparatus** for determining the ratio of the two specific heats . . . . . 150
4550. **Depretz' Apparatus** for the latent heat of vaporisation of water . . . . . 160
4560. **Berthelot's Apparatus** for the latent heat of vaporization . . . . . 110
4570. **Brix's Apparatus** for the same purpose . . . . . 140

Nos

Francs.

### § 46. Tension and Density of Vapours.

4600.	<b>Long Bowl Barometer</b> for measuring the tensions of vapours . . . . .	30
4605.	<b>Gay-Lussac and Thénard's Apparatus</b> for the tension of vapours mixed with gases . . . . .	100
4610.	<b>Dumas' Apparatus</b> for measuring the density of vapours . . . . .	60
4620.	<b>Regnault's Apparatus</b> for measuring the tension of vapours by the method of boiling under different pressures up to one atmosphere. . . . .	200
4621.	<b>Do.</b> up to four atmospheres . . . . .	350
4630.	<b>Do.</b> for measuring the tensions of steam from $0^{\circ}$ to $50^{\circ}$ . . . . .	300
4640.	<b>Dalton's Apparatus</b> to prove that the tension of steam is the same in a vacuum as in gases. . . . .	70



4650

Nos	Francs.
4650. <b>Papin's bronze Kettle</b> ( <i>fig.</i> ) for a pressure of 10 atmospheres: $\frac{1}{2}$ liter capacity. . . . .	115
4651. <b>Do.</b> 1 liter capacity. . . . .	130
4652. <b>Do.</b> 2 liters capacity . . . . .	180
4655. <b>Adjunction of a Thermometer</b> cased in a tube and penetrating inside the kettle. . . . .	25
<b>Steam-Engines.</b> ( <i>See Technical mechanics, § 89.</i> )	

### § 47. Phenomena of Calefaction.

4700. <b>Boutigny's Apparatus</b> for the phenomenon of Leidenfrost. — This apparatus is composed of an iron support with a Bunsen's burner, two copper caps, a very small thermometer and a hollow copper sphere provided with a safety valve, to demonstrate one of the causes of the explosion of steam-boilers	80
4710. <b>Do.</b> with adjunction of a small platinum crucible for the experiment with anhydrous sulphurous acid, and a silver tray to show that the liquid spheroid is not in contact with the heated surface.	

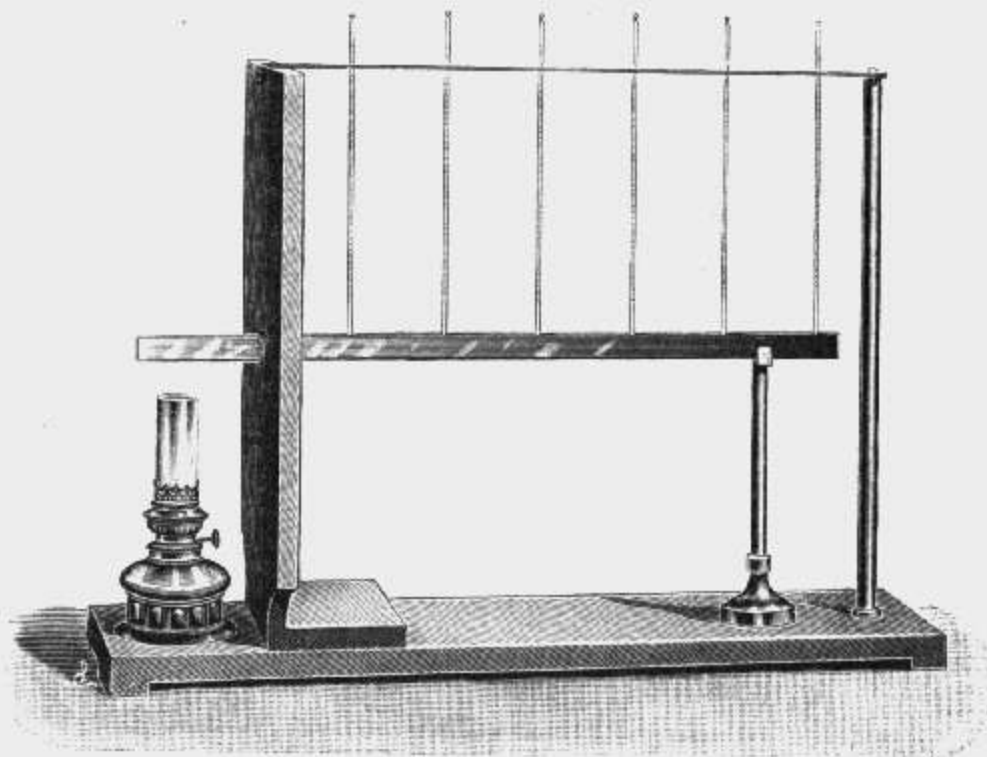
### § 48. Propagation of Heat.

4800. <b>Two parabolic Mirrors</b> of brass, 50 centim. in diameter, mounted on a walnut stand resting on the ground . . . . .	160
4810. <b>Do.</b> of brass, 32 centim. in diameter, mounted on short legs . . . . .	80
4820. <b>Mirror</b> 32 centim. in diameter for Leslie's experiments . . . . .	40
4830. <b>Melloni's Apparatus</b> for showing the radiation and direct transmission of heat, as well as the athermanous and diathermanous properties of bodies. The apparatus is composed of a bench, Leslie's cube with its stove, a diaphragm with holes, the necessary screens, several sources of heat, Melloni's pile and a galvanometer . . . . .	: 00
4840. <b>Do.</b> more complete, for demonstrating the laws of reflection and refraction, diffusion and polarization of heat . . . . .	800
4841. <b>Adjunction</b> to the above apparatus for Tyndall's experiments on the absorption of heat by gases and vapours. . . . .	180

Nos	Francs.
4850. <b>Two Cylinders of Rumford</b> with thermometers to compare the emissive powers of surfaces by measuring the time of the cooling . . . . .	60
4860. <b>Leslie's Cube</b> to determine the emissive power of bodies, having respectively a black, a white, a polished metallic, and a dull metallic surface . . . . .	25
4870. <b>Do.</b> to determine the emissive power of metals; the four faces of different polished metals. . . . .	30
4880. <b>Davy's Apparatus</b> to show the communication of heat through a vacuum by a platinum wire heated by an electric current . . . . .	80

### § 49. Conductibility of Heat.

4900. <b>Ingenhouz's Apparatus</b> to show the conductibility of metals . . . . .	45
4910. <b>Biot and Despretz's Apparatus</b> to prove the law of conductibility. The apparatus is composed of a long steel bar on which six thermometers with small bulbs are placed 40 centim. apart ( <i>fig.</i> ) . . . . .	100



4910

## CHAPTER 5

## ACOUSTICS

- § 50. Various Apparatus for producing sound.  
 51. Vibrations of Chords.  
 52. Vibrations of Pipes.  
 53. Vibrations of Plates.  
 54. Vibrations of Rods (diapasons).  
 55. Apparatus for studying and counting vibrations.  
 56. Composition of Vibrations.  
 57. Propagation of Sound.  
 58. Telephone, Microphone, Phonograph, etc.

Nos

Francs.

## § 50. Various Apparatus for producing Sound.

5000.	<b>Eight Pieces of Wood</b> giving the gamut when thrown on the ground. . . . .	4
5005.	<b>Four brass Tubes</b> with pistons, giving the perfect accord when their pistons are successively drawn . . . . .	30
5010.	<b>Eight steel Cylinders</b> for the limit of the perceptible shrill sounds . . . . .	55
5020.	<b>Seebeck's Sirene</b> , brass disk with four rows of holes; fitting on the apparatus n <sup>o</sup> 7100 with a small bent tube to blow in with the mouth . . . . .	20



Nos	Francs.
5025. <b>Sirene of Cagniard-Latour</b> with register . . . . .	85
5030. <b>Helmholtz's double Sirene</b> . . . . .	450
5035. <b>Singing Flames Apparatus.</b> Four tubes of glass mounted on a support with their gas-burners . . . . .	65
5040. <b>Singing Tube,</b> 125 centim. long with burner and accesso- ries, yielding an organ sound . . . . .	50
5045. <b>Bellows</b> with bag and eight keys . . . . .	300
5046. <b>Adjunction</b> of a pressure regulator . . . . .	35
5050. <b>Mouth-Piece</b> for the flute . . . . .	7
5055. <b>Do.</b> universal . . . . .	7
5060. <b>Wertheim's Apparatus</b> for the production of sound by electricity in an iron rod. . . . .	40

### § 51. Vibrations of Chords.

5100. <b>Differential Sonometer,</b> classical model with weights. The instrument bears three strings 1 metre long between their points of support. One of these strings can be stretched with weights. A metrical scale and a scale giving the different kinds of gamut, and harmonies. . . . .	140
5110. <b>Do.</b> of plainer construction . . . . .	50
5120. <b>Sonometer</b> of very strong construction to stretch two chords 150 centim. long. The apparatus is used also for the longi- tudinal vibrations of chords and bears divisions for the tempe- rate gamut and the physicists', as well as a scale in millim. . .	170
5130. <b>Savart's Monochord</b> on a black table to render the vibrations of a string visible . . . . .	20

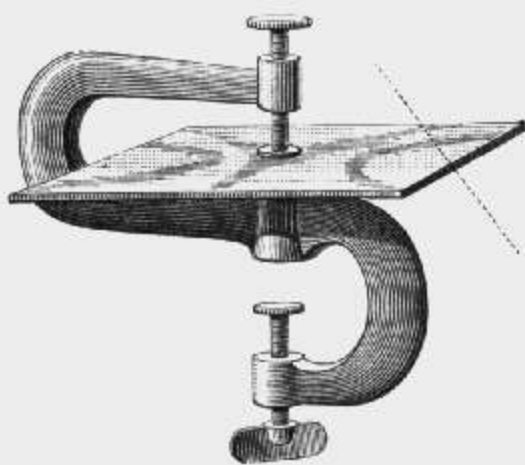
### § 52. Vibration of Pipes.

5200. <b>Savart's Bell Apparatus</b> for the vibration of air by in- fluence; bell 22 centim. in diameter . . . . .	100
5205. <b>Do.</b> bell 16 centim. in diameter . . . . .	70

Nos		Francs.
5210.	<b>Glass Pipe</b> to show the nodes of a vibrating column of air by a small membrane covered with sand . . . . .	18
5220.	<b>Three Pipes</b> , of the same length but different breadth and depth, to show the influence of the size of the cross-section on the sound produced . . . . .	20
5230.	<b>Pipe with Piston</b> for the study of closed pipes . . . . .	25
5240.	<b>Pipe with moving Lip</b> to show the influence of the lip . . . . .	12
5250.	<b>Four Pipes</b> giving the perfect accord . . . . .	30
5260.	<b>Eighth Pipes</b> giving the gamut . . . . .	60
5270.	<b>Pipe with free Reed</b> and harmony bags of different lengths. . . . .	30
5280.	<b>Pipe with flapping Reed</b> . . . . . id. . . . .	30

### § 53. Vibrations of Plates.

5300.	<b>Bow</b> to produce vibrations in plates and bells . . . . .	8
5310.	<b>Apparatus for the Laws of vibrating Plates</b> , composed of six brass plates, three round and three square; mounted on a bench . . . . .	75
5315.	<b>Do.</b> with three plates only . . . . .	45



5320.

5320.	<b>Double Pliers</b> of cast-iron for holding various plates, to produce Chladni's figures ( <i>fig.</i> ) . . . . .	20
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Nos	Francs.
5325. <b>Glass or brass Plates</b> , round or square, to be used with the preceding apparatus, each . . . . .	15
5330. <b>Brass Plate</b> 25 centim. in diameter, fixed on a steel rod to reproduce the central rings . . . . .	20
5340. <b>Two square plates</b> or round ones of the same size, holding together, to prove that the figures produced on one of the plates are reproduced on the other . . . . .	18
5350. <b>Two plates of brass</b> , one fixed on a stand, the other on a handle, for producing vibrations by influence . . . . .	25
5360. <b>Glass Bell</b> with four balls hanging close to the edge of the bell . . . . .	28

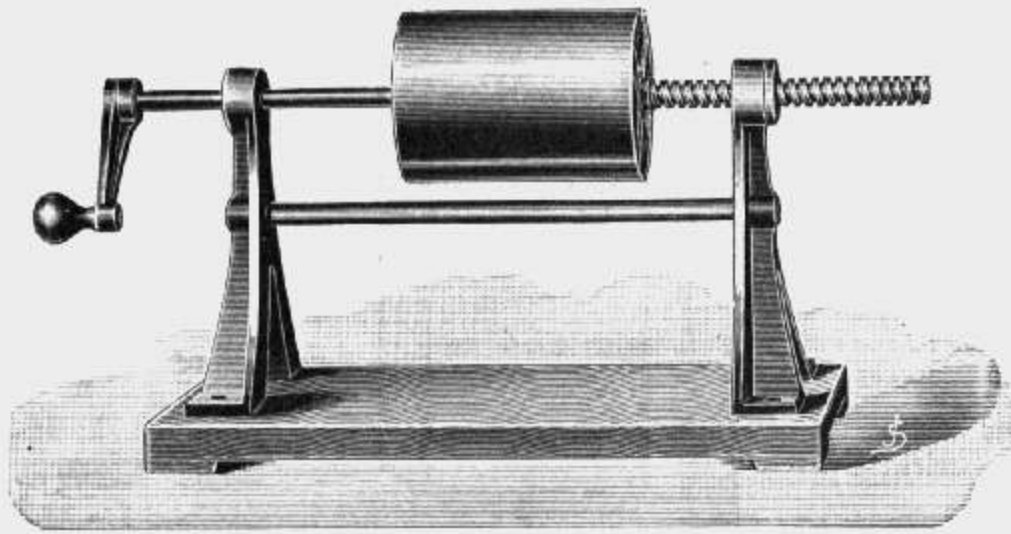
### § 54. Vibrations of Rods and Bars. (Tuning Forks.)

5400. <b>Four thin steel Bars</b> to show that the number of vibrations is in the inverse ratio of the square of their length and in the direct ratio of their thickness whatever their breadth may be . . . . .	25
5410. <b>Four steel Rods</b> of the same diameter but different lengths, giving the perfect accord . . . . .	40
5420. <b>Tuning Fork</b> $ut_2 = 256$ single vibrations, mounted on a box	110
5425. <b>Do.</b> $ut_1 = 512$ single vibrations   id. . . . .	40
5430. <b>Do.</b> $ut_4 = 1024$ »     id. . . . .	35
5435. <b>Do.</b> $la_3 = 870$ »     id. . . . .	35
5440. <b>Two Tuning Forks</b> mounted on boxes for producing beats.	70
5450. <b>Four Tuning Forks</b> giving the perfect accord . . . . .	145

### § 55. Apparatus for studying and counting vibrations.

5500. <b>Duhamel's Cylinder</b> for the study of vibrations by the graphic method ( <i>fig.</i> ). . . . .	100
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Nos	Francs.
5510. <b>Duhamel's Cylinder</b> larger size . . . . .	150
<b>Tuning Fork Chronograph.</b> (See <i>General measuring instruments</i> . Chap. 0, § 09.)	
5520. <b>Savart's rotary Apparatus</b> for counting vibrations by means of toothed wheels, with a series of four wheels and a	



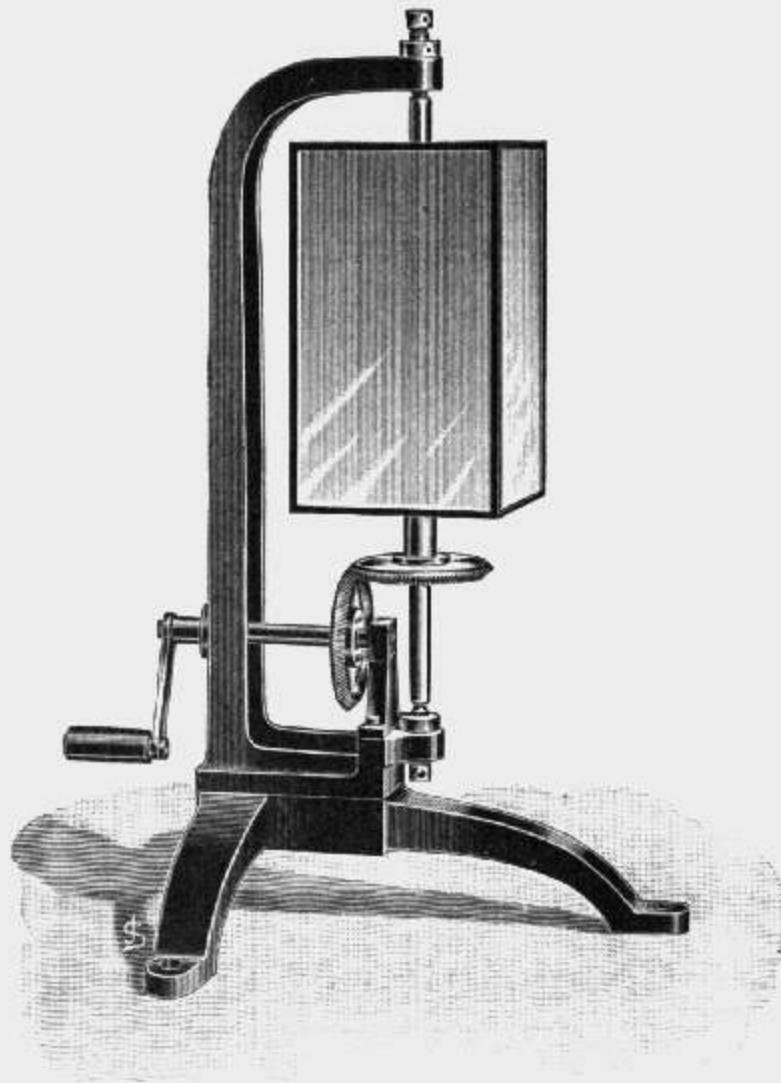
5500.

turn-counter: the apparatus is arranged for adapting discs of all kinds . . . . .	180
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§ 56. Composition of Vibrations.

5600. <b>Savart's Monochord</b> n <sup>o</sup> 5130 . . . . .	20
5610. <b>Wheatstone's Kaleidophone.</b> Six blades each terminated with a bright knob, for the composition of two vibrations at right angle . . . . .	65
5620. <b>Tisley's double Pendulum</b> for the graphic representation of Lissajous' curves. Two pendulums oscillating in perpendicular planes and tracing the resultant curve on a slab of smoked glass . . . . .	400
5630. <b>König's open or closed Pipe,</b> with three manometric flames . . . . .	45

Nos		Francs.
5640.	<b>Revolving Mirror</b> for observing manometric flames, large size ( <i>fig.</i> ) . . . . .	150
5641.	<b>Do.</b> smaller model . . . . .	80
5650.	<b>Two Tuning Forks</b> mounted on their stands with mirrors for the production of Lissajous' curves. . . . .	100



5640.

5660.	<b>Lissajous' Optic Comparator</b> . . . . .	110
5670.	<b>Do.</b> same model; the vibrations of the tuning fork are kept up electrically. . . . .	150

**§ 57. Propagation of Sound.**

5700.	<b>Bell Balloon</b> for showing that the intensity of sound diminishes in rarefied air. . . . .	22
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Nos		Francs.
5710.	<b>Two Parabolic Reflectors,</b> of brass, 52 centim. in diameter, with walnut foot standing on the ground . . . . .	160
5720.	<b>Do.</b> of brass, 32 centim. in diameter, mounted on a short foot . . . . .	80

### § 58. Telephone, Microphone, Phonograph, etc.

5800. **Telephone,** lecture room model.

5810. **Microphone.**

5850. **Edison's Phonograph.** Primitive model with a sheet of tin.  
Cylinder turned round by a handle . . . . . 130

## CHAPTER 6

### PHYSICS OF THE GLOBE. METEOROLOGY. PHYSIOLOGY. MEDICINE.

- § 60. Terrestrial Magnetism.  
61. Atmospheric Moisture.  
62. Atmospheric Pressure.  
63. Atmospheric Movements.  
64. Atmospheric Electricity.  
65. Solar Heat.  
66. Various Apparatus.  
67. Vegetable Physiology.  
68. Animal Physiology.  
69. Medicine.

Nos

Francs.

#### § 60. Terrestrial Magnetism.

- |       |   |     |
|-------|---|-----|
| 6000. | <b>Compass of Inclination</b> ; needle 120 millim. long oscillating on an agate plane. Vertical and azimuthal circle graduated on silver with vernier reading to one minute . . . . . | 600 |
| 6010. | <b>Weber's Compass of Intensity.</b> Magnetic bar 100 millimetres long, in a glass case . . . . .   | 70  |
| 6020. | <b>Gauss's Magnetometer</b> , arranged for demonstration in laboratories . . . . .  | 160 |

Nos	Francs.
6030. <b>Weber's Compass</b> , replacing in travelling Gauss's unifilar magnetometer, and arranged as multiplier. Magnetic bar 10 centim. long . . . . .	700
<b>Various Mariner's Compasses.</b> (See also <i>Geodesy</i> , § 11.)	
6040. <b>Theodolite</b> for measuring exactly the angle of declination and its variations. Graduated circles 20 centim. in diameter; small magnetic needle, with mirror, suspended by a cocoon thread . . . . .	900
<b>Theodolites.</b> (See also <i>Geodesy</i> , § 13.)	

**§ 61. Atmospheric Moisture.**

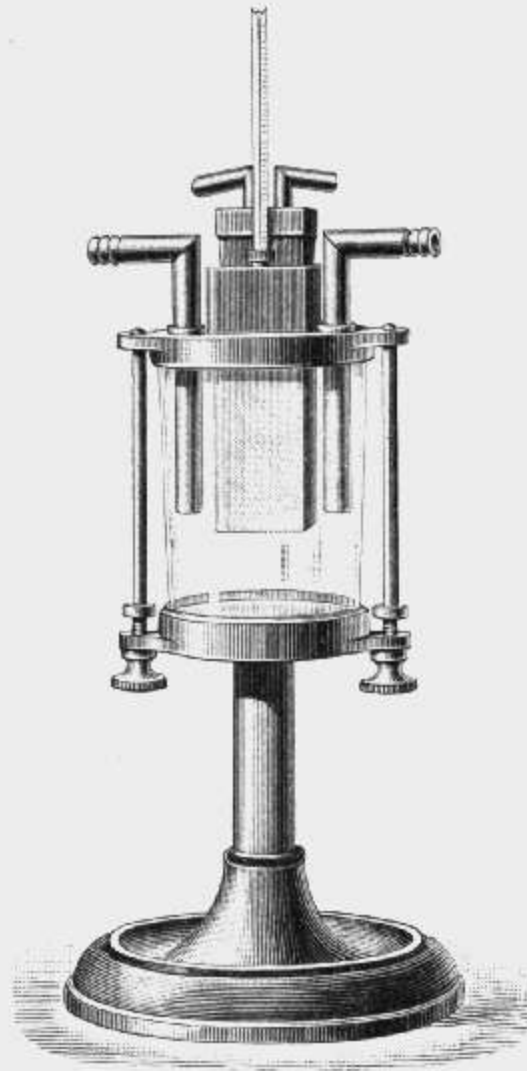
6100. <b>August's Psychrometer</b> . . . . .	60
6110. <b>Regnault's Condensation Hygrometer</b> , thermometers marking $\frac{1}{5}^{\circ}$ ( <i>fig.</i> ) . . . . .	110
6115. <b>Do.</b> with its aspirator . . . . .	140



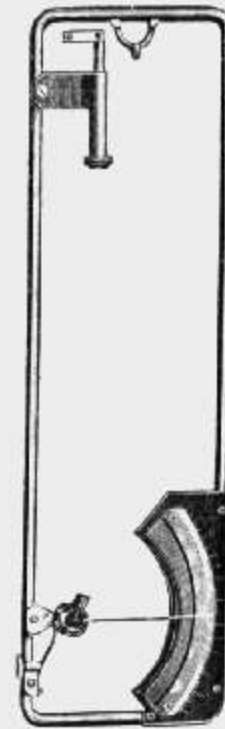
6110.



Nos	Francs.
6120. <b>Dufour's Condensation Hygrometer</b> ( <i>fig.</i> ). (See <i>Arch. des Sc. phys. et nat.</i> ) . . . . .	75



6120.



6140.

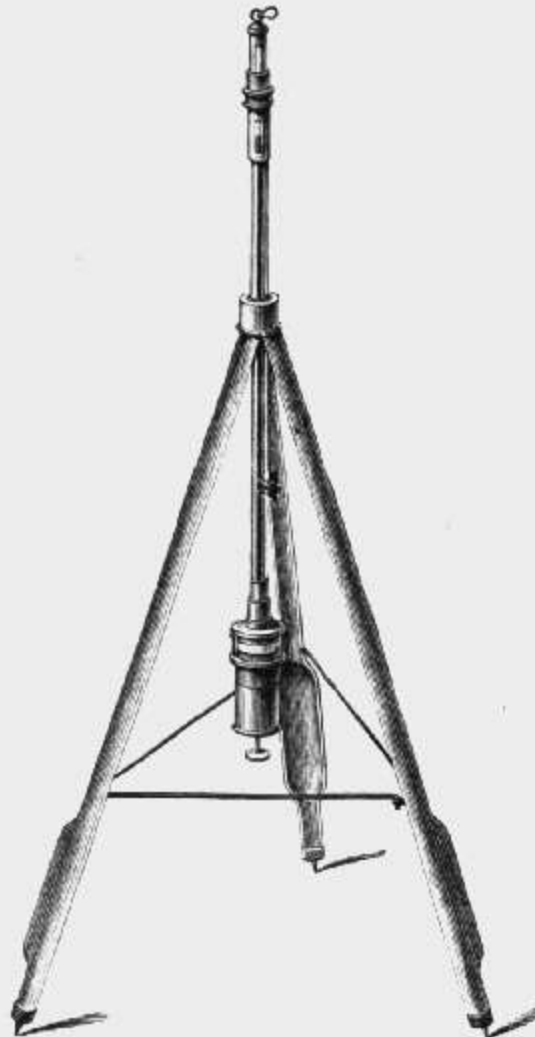
6130. <b>M. Alluard's Condensation Hygrometer</b> . . . . .	120
6140. <b>De Saussure's Hygrometer</b> , with arbitrary scale; in a case . . . . .	60
In this instrument, the counterpoise for stretching the hair is advantageously replaced by a gold coil, and the tightening pliers by a spring ( <i>fig.</i> ).	
6145. <b>Glass Case</b> for the observations of the above hygrometer . . . . .	22
6150. <b>Small Rain Gauge</b> . Test-tube divided into cubic centimetres, fixed on a cast iron foot and surmounted by a brass funnel, whose upper section has an area of 2 square decimetres . . . . .	25

Nos	Francs.
6160. <b>Hervé-Mangon's integrating Rain Gauge</b> . . .	100

**§ 62. Atmospheric Pressure.**

6200. <b>Regault's Hypsometer</b> to determine the atmospheric pressure by the boiling of water; without the thermometer . . .	70
6205. <b>Do.</b> with thermometer . . . . .	105
<b>Mercurial barometers.</b> (See also <i>General Physics</i> , Chap. 7, § 78 et 79.)	
6210. <b>Station Barometer</b> with reduced scale, to take into account the variations of level of the mercury in the cup; easily transportable from one station to another. Model used in Swiss meteorological stations; in a box . . . . .	140
6215. <b>Wild's Large Standard Barometer.</b> Tubes 24 millim. inside diameter. Cathetometric column bearing two micrometer microscopes and reading to $\frac{1}{100}$ millim.	
6220. <b>Wild's Siphon Barometer</b> , used in the meteorological stations of the Russian Empire. Without mercury . . . . .	140
Regarding the above two instruments, see « <i>Ueber die Bestimmung des Luftdrucks</i> , by H. Wild». « <i>Répertoire de météorologie</i> , » tome III, N° 1, of the Imp. Academy of sciences, St-Petersburg. 1874.	
6230. <b>Observatory Barometer</b> , Fortin's system, wide crystal bowl 80 millim. in diameter, with cast iron mounting; scale for millim, with rack and pinion; venier reading to $\frac{1}{20}$ millimetre; thermometer with cylindrical bulb of the same diameter as the barometric column; column of mercury 13 millim. in diameter . . . . .	200
6240. <b>Fortin's Travelling Barometer</b> . . . . .	120
6245. <b>Do.</b> with brass tripod . . . . .	170
6250. <b>Do.</b> with wooden tripod serving as case, and leather bag ( <i>fig.</i> ) . . . . .	190

Nos	Francs.
6252. <b>Plane-Table</b> of walnut with suspension contrivances for Fortin's travelling barometer . . . . .	25
<b>Barographs</b> or registering barometers. Price on application.	



6250.

6260. **Foreman's Barograph.** Barometer with floater whose motion is communicated to a lever. The slightest motion of the lever sends an electric current through the electro-magnets, which with the help of clockwork keep the floater in equilibrium and register the barometric pressure on cylinders.

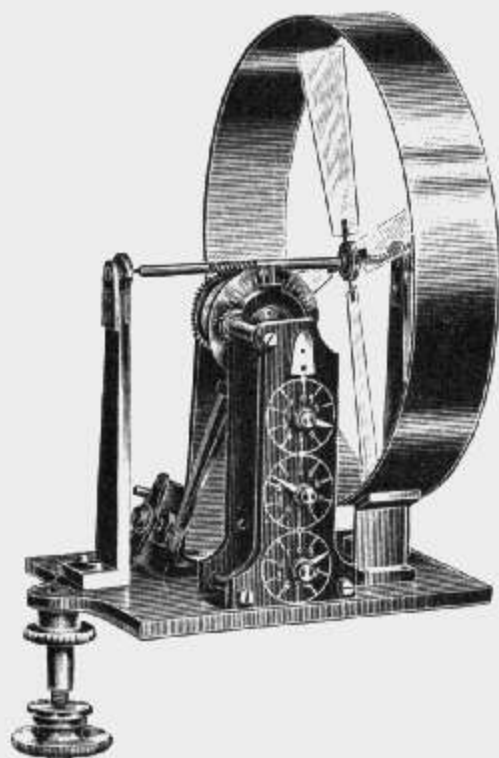
6270. **Marvin's Normal Barograph,** or weight registering barometer. The tube is suspended from the beam of scales whose motions send an electric current into the electro-magnets. Equilibrium is maintained automatically and the pressure is registered on a cylinder . . . . . 1250

Nos

Francs.

§ 63. Atmospheric Movements.

6300. **Combes' Anemometer.** With ruby cushioned axis . . . 95  
 6310. **Do.** with formula determined by experiment . . . 110  
 6320. **Combes' Anemometer** model to be employed vertically or horizontally, with turn counter allowing of a long experiment (*fig.*) . . . . . 180



6320.

6330. **Robinson's Cup Anemometer,** with vertical axis and 4 cups 10 centim. in diameter, whose arms are about 15 centimetres long. Aluminium or brass cups; steel arms.  
 Revolution counter permitting a long experiment. Correction table determined experimentally . . . . . 180  
 6335. **Do.** with recording apparatus. Price on application.  
 6350. **Anemoscope or Weather-cock** showing the direction of the wind, for meteorological observatories. The instrument rests on a carriage with three wheels rolling between two horizontal circular plates, which makes it very sensitive . . . 80  
 6355. **Anemoscope** with recording apparatus. Price on application.

Nos

Francs.

### § 64. Atmospheric Electricity.

6400. **Lightning Conductor Point**, of fire gilded copper, terminating in a conic gold tip, with an iron rod, ready to be soldered on the base of the lightning conductor . . . . . 40
6410. **Peltier's Electrometer**, for atmospheric electricity . . . . . 120
6420. **De Saussure's Electrometer**, with gold or aluminium leaf and long pointed rod, for the investigation of atmospheric electricity . . . . . 80

### § 65. Solar Heat.

6500. **Pouillet's Pyrheliometer** . . . . . 120
6510. **Crova's Pyrheliometer** (*fig.*). See *Ann. de Chimie et de Physique*, t. XI, 1877.



6510.

Nos	Francs.
This instrument can also be constructed with a foot to rest on the table . . . . .	180
6520. <b>Pouillet's Actinometer</b> , for the nocturnal radiation of heat . . . . .	85
6530. <b>Soret's Actinometer.</b> (See « Recherches sur l'intensité calorique de la radiation solaire. » <i>Compte rendu de l'Association française pour l'avancement des sciences.</i> 1872, Bordeaux, p. 282.)	
6540. <b>Sunshine Photographic Recorder.</b> Closed metal cylinder supported upon a frame, so that it can be set parallel with the axis of the earth. The light of the sun penetrates by two thin edge pin-holes into the interior of the cylinder in which there are two sheets of sensitized photographic paper, and thus the periods of sunshine are registered by the sun's own course . . . . .	125

**§ 66. Various Apparatus.**

6600. <b>Seismometers</b> of various constructions.	
6605. <b>Marvin's Seismograph</b> with recording apparatus . . .	250
6610. <b>Self recording Limnimeter</b> to register the height of the water of lakes . . . . .	500 to 1200
6620. <b>Transportable self recording Limnimeter</b> of M. Ed. Sarasin. Floater protected by a vertical cylindrical tube plunging into the water. The floater conveys its motions to the recording-apparatus by means of a pulley and a counterpoise. (See <i>Arch. des Sciences phys. et nat.</i> , tom II, n <sup>o</sup> 12, december 1879.) . . . . .	500
6630. <b>Sun-dial</b> , marking the true time to 20" with compass and level . . . . .	180

Nos

Francs.

6640. **Colladon's Apparatus** to produce in a mass of water vortices and whirls imitating those of the atmosphere (*fig.*) . 150



6640.

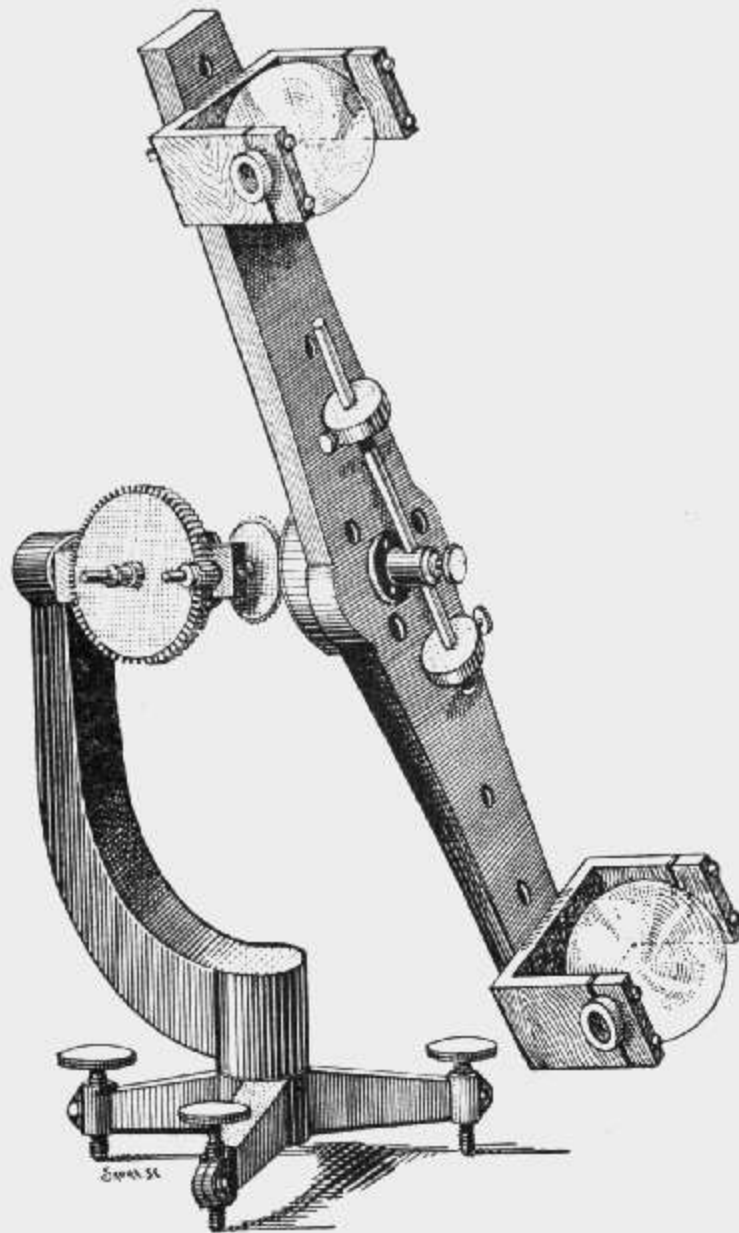
(See « Sur les tourbillons ascendants dans l'air et dans les liquides. » *Comptes rendus*, avril 1887.)

6650. **De la Rive's Apparatus** for the reproduction of the Aurora Borealis phenomenon. See n° 3950.

## § 67. Vegetable Physiology.

### 6700. General rotary Apparatus for experiments of vegetable Physiology.

A cast-iron part represented in figure *a*, and interposed between the tripod and the rest of the apparatus enables one to place at will the axis of rotation in a horizontal position.



6700 *a*.

This apparatus can be used as a **clinostat**, to annul the effects of heliotropism and geotropism. It is also available as **Knight's apparatus**, to investigate the effects of centrifugal force on the directions of the parts of plants.



Nos

Francs.

A series of cog-wheels enables one to modify the speed at will.

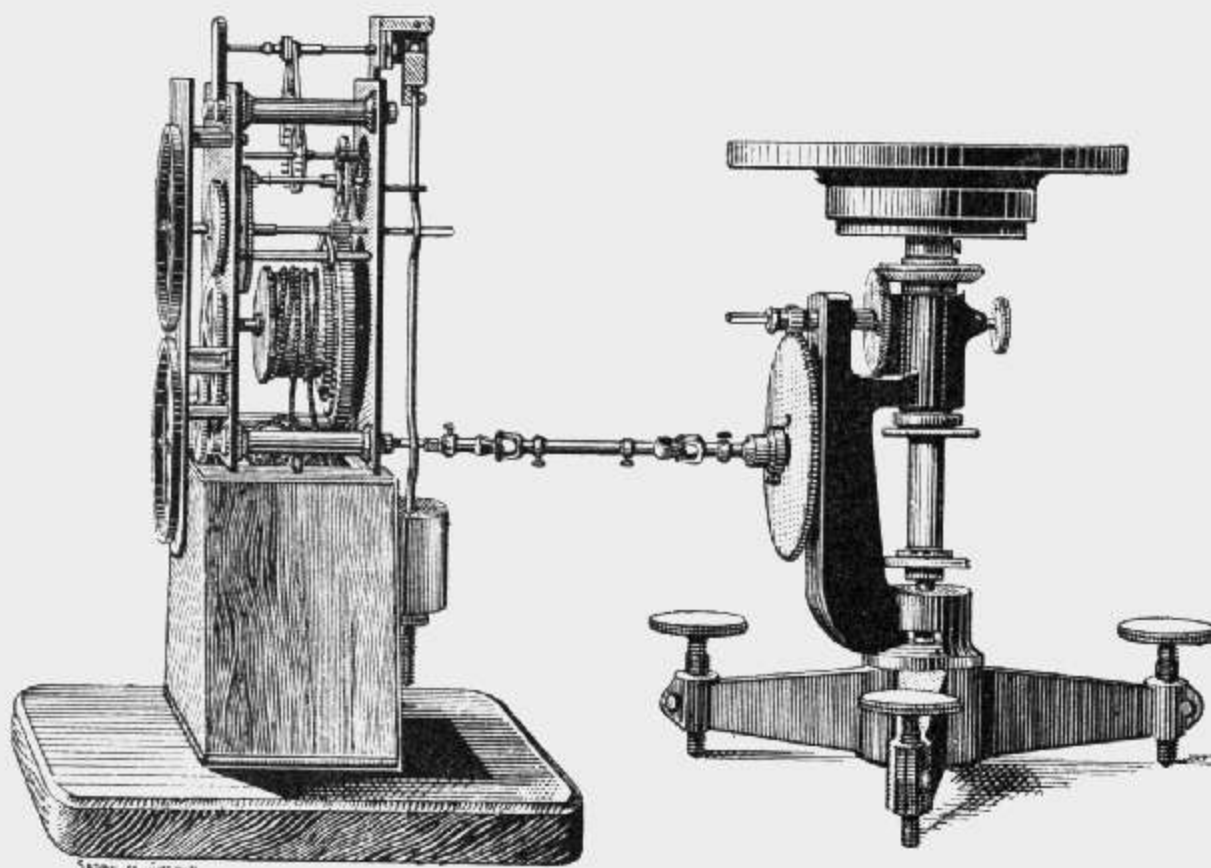
The **motor**, for horizontal or vertical clinostat, is a pendulum clock as represented in figure *b*.

The motor for horizontal or vertical centrifugal apparatus may be either a dynamo or one of the motors, which are to be found to-day in most laboratories.

*Figure a.* The instrument is mounted as centrifugal apparatus. The two glass spheres may be fixed at different distances from the axis of rotation.

*Figure b.* The instrument is mounted as clinostat with a vertical axis.

Price of the apparatus. . . . . 300



6700 *b.*

6710. Price of the <b>Clock</b> . . . . .	150
6720. <b>Clinostat of simple construction</b> with spring clock-work . . . . .	240

Nos

Francs.

### § 68. Animal Physiology.

**Registering Drums, Chronographs, etc.** See *General measuring Instruments*; § 09.

6800. **Thermo-electric Needle** in German-silver and iron or copper and iron, per pair . . . . . 15
6810. **Galvanometers.** See *Magnetism and Electricity*, § 36.

### § 69. Medicine.

6900. **Pocket Scales for weighing infants.** Small roman balance with separable parts.  
The scales are contained in a case 17 centim. long and 7 centim. broad and weighs only 600 grams. The scales can weigh from 0, to take into account the weight of the clothes.  
Capacity 10 kilograms; sensitive to 10 grams. . . . . 50

## CHAPTER 7

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### EXPERIMENTAL MECHANICS (GENERAL PHYSICS)

- § 70. Statics.  
 71. Kinematics and Dynamics.  
 72. Laws of Gravity.  
 73. Impact. Elasticity. Friction.  
 74. Hydrostatics.  
 75. Hydrodynamics.  
 76. Compression Pumps (for liquids or gases).  
 77. Pneumatic Machines and Accessories.  
 78. Atmospheric Pressure.  
 79. Equilibrium and Movement of Gases.
- 

Nos

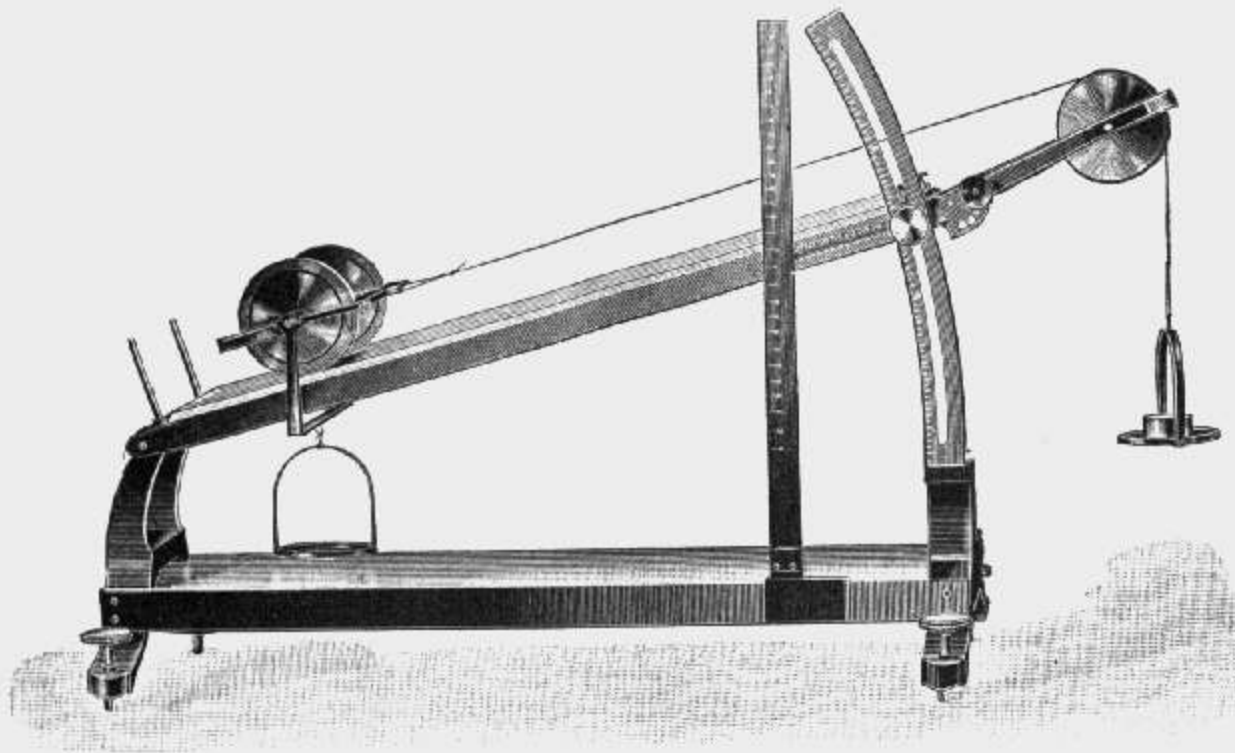
Francs.

### § 70. Statics.

**Dynamometers, Scales, etc.** (See *General measuring Instruments*, Chap. 0.)

7000.	<b>Helicoidal Spring</b> , known as spiral spring . . . . .	2
7005.	<b>Plumbline</b> ; brass weight and steel point . . . . .	5
7010.	<b>Apparatus</b> to prove the <b>principle of the parallelo-</b> <b>gram of forces</b> , small model . . . . .	40
7011.	<b>Do.</b> larger model . . . . .	100

Nos		Francs.
7015.	<b>Apparatus</b> for showing the properties of the <b>Center of Gravity</b> . Four sheet-iron plates of various forms to be suspended by hooks . . . . .	20
7020.	<b>Apparatus</b> for showing the properties of the <b>Inclined Plane</b> , cast-iron plane. . . . .	80
7021.	<b>Do.</b> improved model with glass plane ( <i>fig.</i> ) . . . . .	150

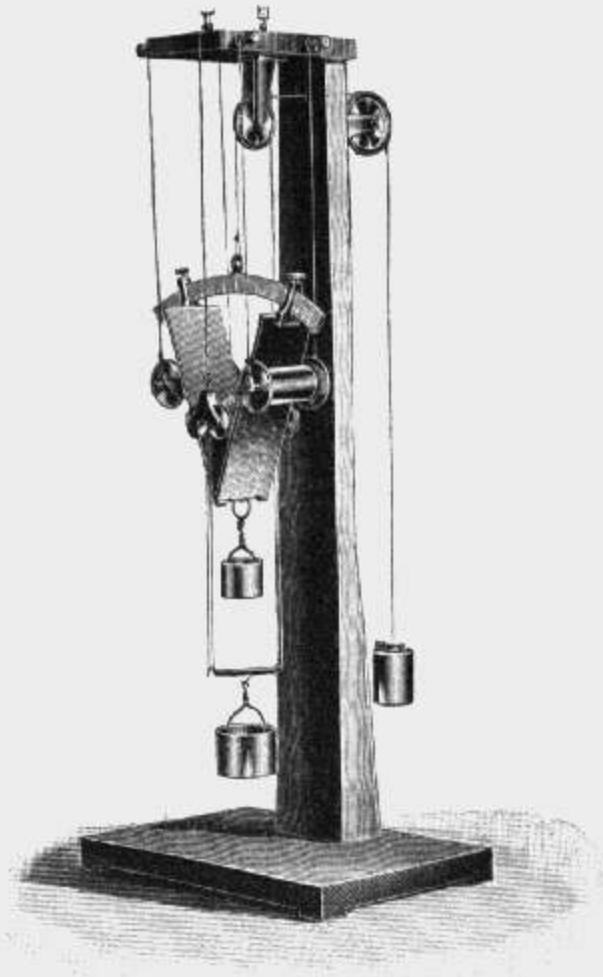


7021

**Long Level** designed to measure exactly the slope of inclined planes. See N° 1230.

7025.	<b>S'Gravesande's Apparatus</b> to show the <b>properties partly of the Wedge</b> ( <i>fig.</i> ) . . . . .	150
7030.	<b>Apparatus</b> to demonstrate the <b>laws of the Straight Lever</b> and the composition of parallel forces, model made of wood ( <i>fig.</i> ) . . . . .	45
7031.	<b>Do.</b> model made of brass . . . . .	100
7035.	<b>Model of Balance-Beam</b> , in brass with removable knife edges, for explaining the theory of scales . . . . .	70
7040.	<b>Pulley</b> for showing the <b>conditions of equilibrium</b> . Brass pulley with three concentric grooves; diameters 1, 2	

Nos	Prices.
and 3. For equilibrium, the weights attached must be in the inverse ratio of the diameters ( <i>fig.</i> ) . . . . .	45



7025.

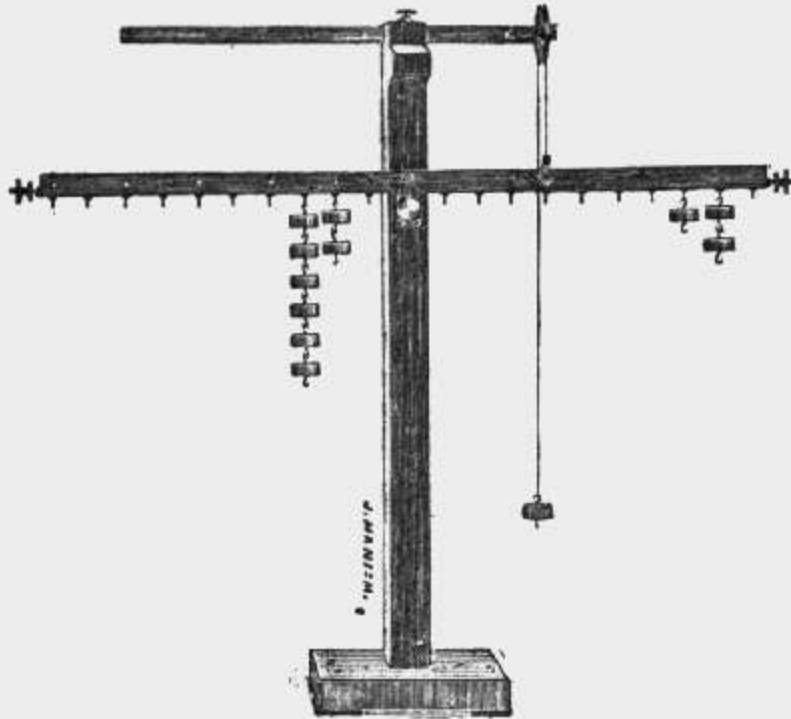
7045. <b>Blocks and Fall with four Pulleys,</b> for the lecture-room . . . . .	28
7050. <b>Blocks and Fall with differential Pulleys</b> . . . . .	40
7055. <b>Various Pulleys and Blocks</b> mounted on a one stand . . . . .	410
7060. <b>Model of Hand Windlass,</b> in wood . . . . .	15
7065. <b>Apparatus</b> for showing the <b>action of cogged Wheels.</b>	
The force and the resistance are to each other as the product of the diameters of the pinions is to the product of the diameters of the driving wheels . . . . .	100

**Windlasses, Blocks and Fall, Gearing,** etc. (See also *Technical Mechanics*, Chap. 8.)

Nos

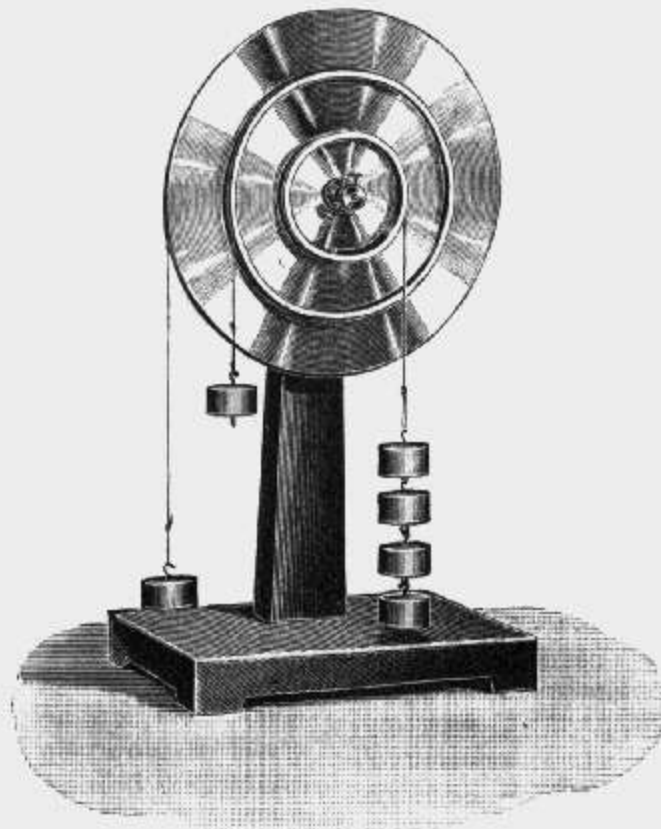
Francs.

7070. **Wooden Cone** for showing the difference between stable, unstable and indifferent equilibrium . . . . . 3



7030.

7075. **Double Cone**, ascending an inclined plane . . . . . 12
7080. **Two Wooden Cylinders**, cut obliquely to their base and a rectangular wooden block for showing the moment of stability . . . . . 6



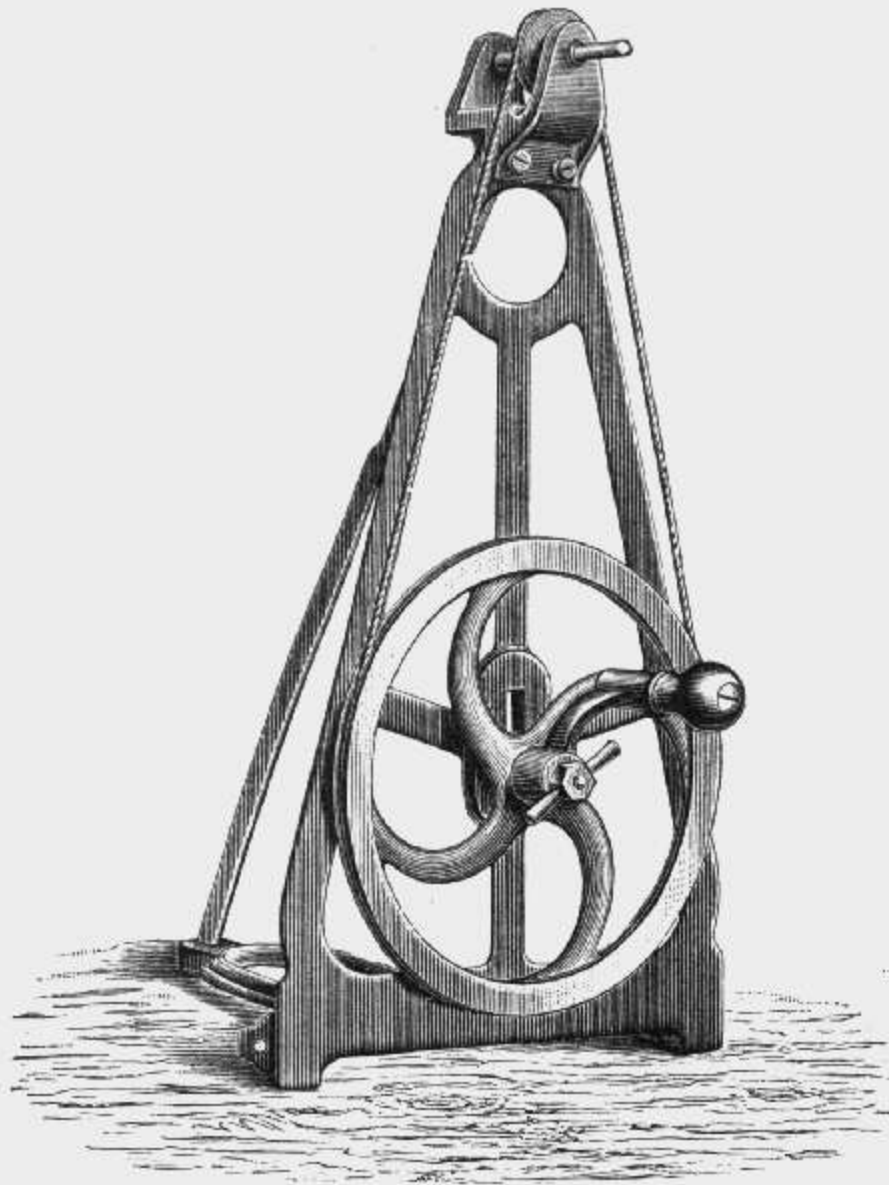
7040.

### § 71. Kinematics and Dynamics.

**Kinematics, Transmitting of Motion** etc. (See *Technical Mechanics*, Chap. 8.)

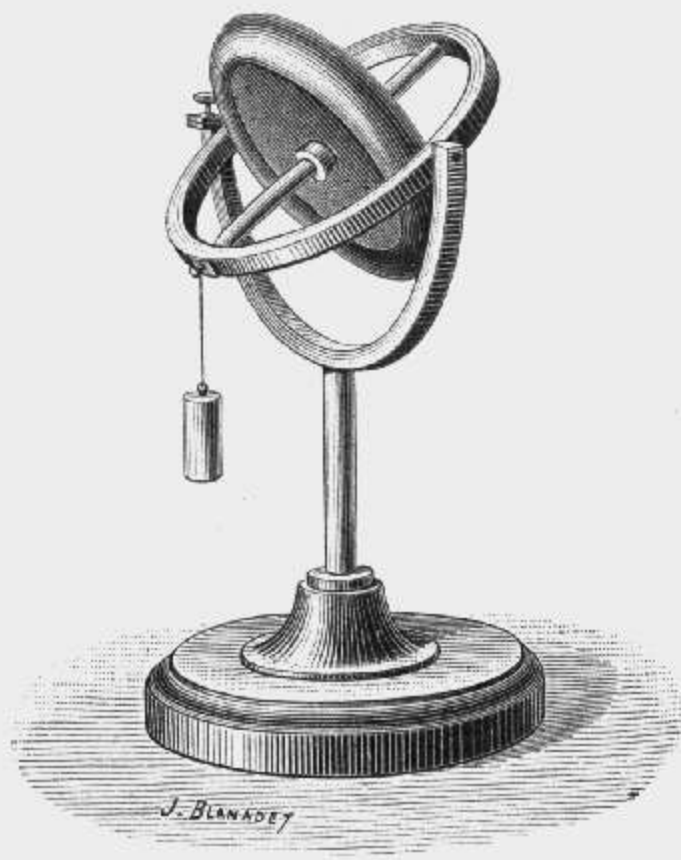
#### **Apparatus for experimenting on Centrifugal Force.**

	Large mod.	Small mod.
7100. The apparatus proper ( <i>fig.</i> ); can be employed horizontally or vertically . . . . .	110	60
7102. Two balls connected by a thread to prove that two masses are in equilibrium when their distances to the center of motion are inversely proportional to their masses . . . . .	20	15



7100.

Nos	Francs.	
	Large mod.	Small mod.
7104. Contrivance composed of a sphere and various weights, to prove that the centrifugal force is proportional to the square of the velocity and inversely proportional to the radius . . . . .	48	36
7106. Elastic ring to illustrate the flatening of the earth . . . . .	20	15
7108. Two inclined glass tubes for showing the influence of centrifugal force on small bodies of different densities, plunged into a liquid . . . . .	20	15
7110. Frame to suspend a small ring and a small cylinder, to show that a rotating mass takes the position in which the centrifugal force is greatest. The same apparatus is likewise used to prove the persistance of the pendulum in oscillating in the same plane . . . . .	35	24
7112. Glass globe showing the effects of the centrifugal force upon liquids of different densities . . . . .	20	15
7114. Test tube for producing the paraboloid of rotation of liquids . . . . .	18	15
7116. Small brass tube showing the production of heat resulting from mechanical work . . . . .	8	5



7120.

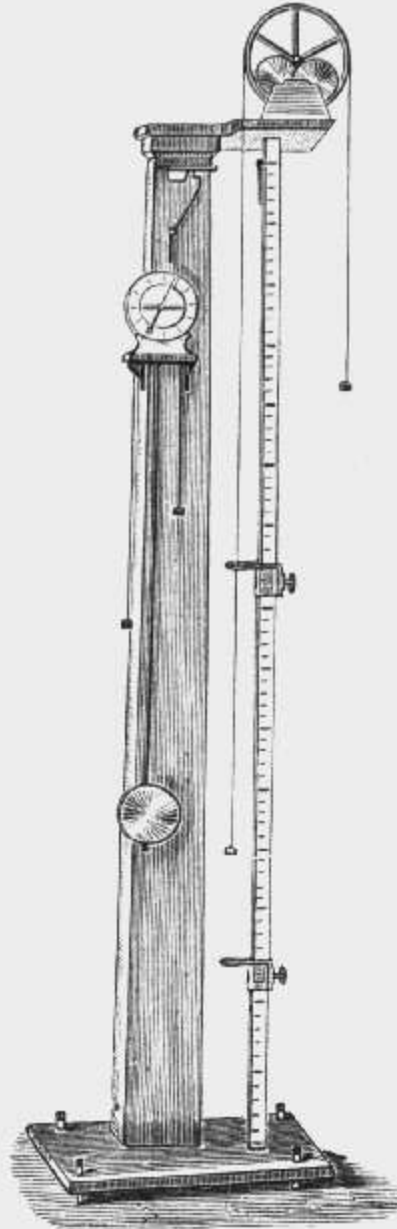


Nos	Francs.
7120. <b>Gyroscope of Foucault or of Bohnenberger</b> for illustrating the equinoctial precession ( <i>fig.</i> ) . . . . .	70
7125. <b>Wooden Pliers</b> to set the tore of the gyroscope in rotation.	15
7130. <b>Foucault's Large Gyroscope</b> to illustrate the movement of the earth; price varying with the requirements.	
7140. <b>Fessel and Plücker's gyroscopic Balance</b> . . . . .	90
7150. <b>Sire's Polytrope</b> with gear to show that the axes of rotation tend to place themselves parallelly, the rotations taking place in the same direction . . . . .	300

### § 72. Laws of Gravity.

7200. <b>Newton's Tube for the Falling of Bodies</b> in a vacuum. Crystal-glass tube about 120 centim. long. . . . .	30
7210. <b>Newton's Tube for the Falling of Bodies</b> , very large model. About 55 millim. inside diameter and 150 centim. long. Pliers located inside the tube and handled from the outside to allow the dropping of the different bodies at a given moment. In this way accidents are avoided, and the experiment can be better followed . . . . .	120
7220. <b>Atwood's Machine</b> to verify the laws of falling bodies. With metronome; brass wheel. Brass scale on rule of hard wood. Freed by the hand . . . . .	210
7230. <b>Do.</b> with pendulum, rolling friction and automatic start ( <i>fig.</i> ) . . . . .	360
7240. <b>Do.</b> without column. Suspension model, easily stowed away . . . . .	180
7250. <b>Morin's Machine</b> to prove the laws of falling bodies by a weight, which describes in falling a parabola on a sheet of paper wrapped round a moving cylinder. Apparatus 2 metres high. . . . .	450
7260. <b>Apparatus with a Ball falling</b> with lateral impulsion, to show the form of the trajectory . . . . .	40

Nos	Francs.
<b>Pendulums.</b> See <i>General Measuring Instruments</i> , § 08.	
7270. <b>Huyghens' Cycloïdal Pendulum.</b> . . . . .	50
<b>Inclined plane.</b> See <i>Statics</i> , § 70.	



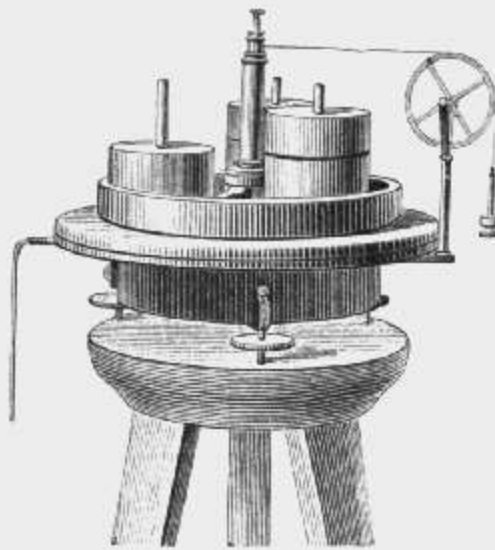
7230.

§ 73. Impact, Elasticity, Friction.

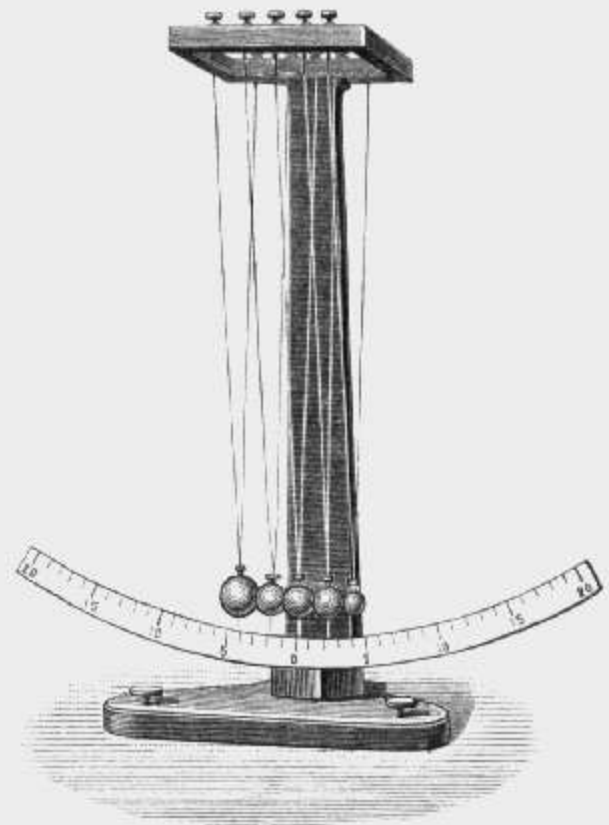
7300. <b>Apparatus with Three Ivory Balls,</b> suspended to show the laws of impact of elastic bodies . . . . .	75
7310. <b>Apparatus with Five Ivory Balls,</b> suspended to show the transmission of impact in elastic bodies ( <i>fig.</i> ). . . . .	80
7320. <b>Marble Plane and Ivory Ball.</b> . . . . .	20
7330. <b>Apparatus to demonstrate the laws of torsion of rods</b> . . . . .	150

Nos	Francs.
7350. <b>Apparatus</b> to show <b>the Laws of sliding Friction</b> ( <i>fig.</i> ) . . . . .	50

Cast iron plate 50 centim. long, fixed on a wooden shelf.  
The rubbing plate is of iron and so arranged as to receive slabs  
of different kinds.

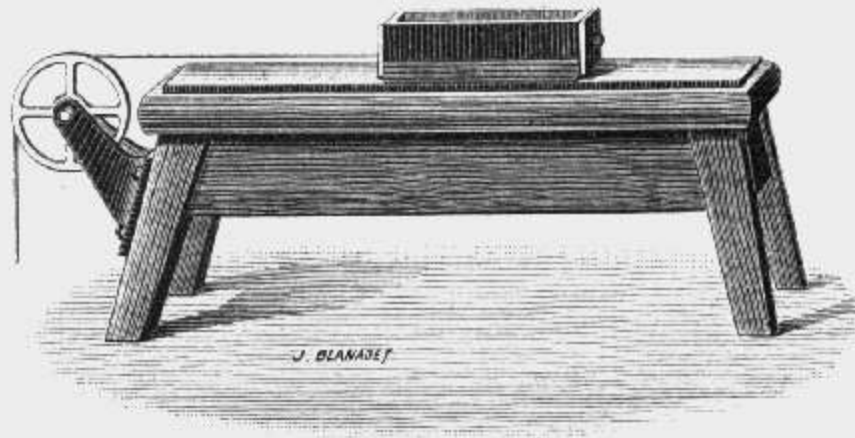


7380.



7310.

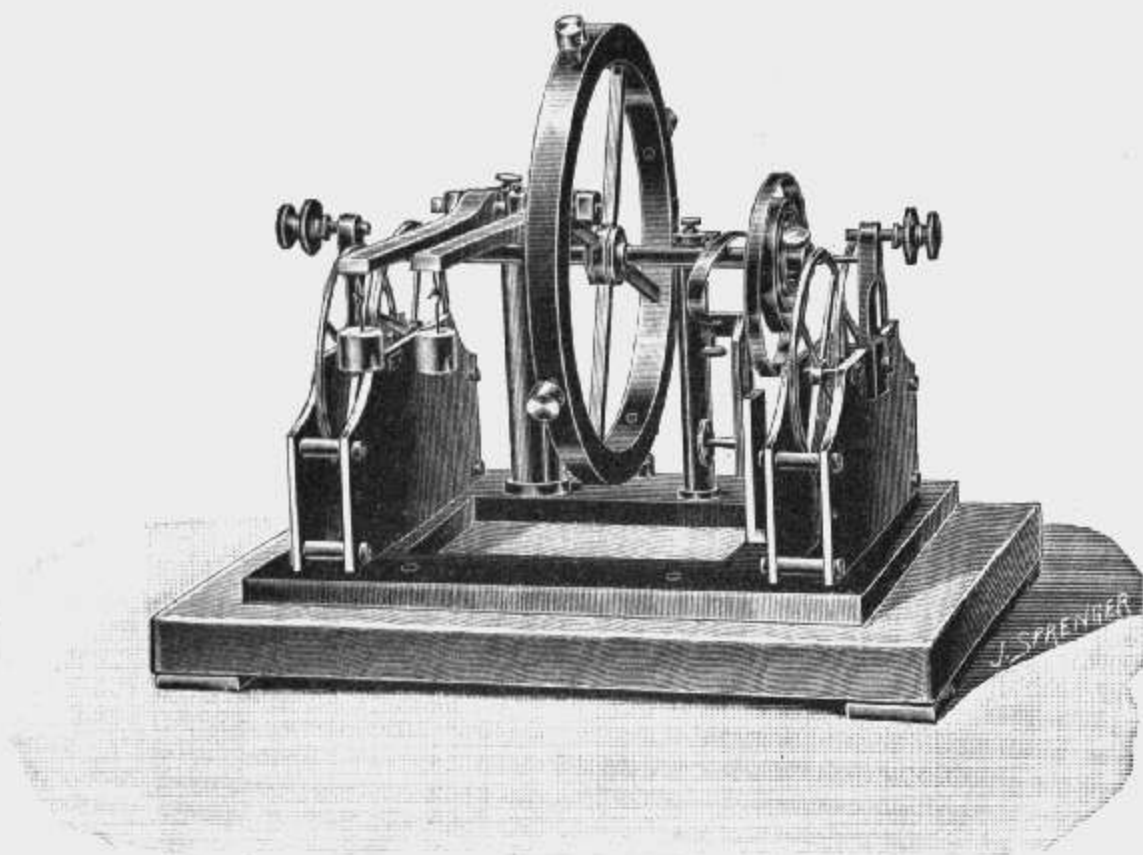
7355. <b>Apparatus</b> to show the <b>Laws of rolling Friction</b> . . . . .	45
7360. <b>Desaguliers Tribometer</b> ( <i>fig.</i> ) . . . . .	200



7350.

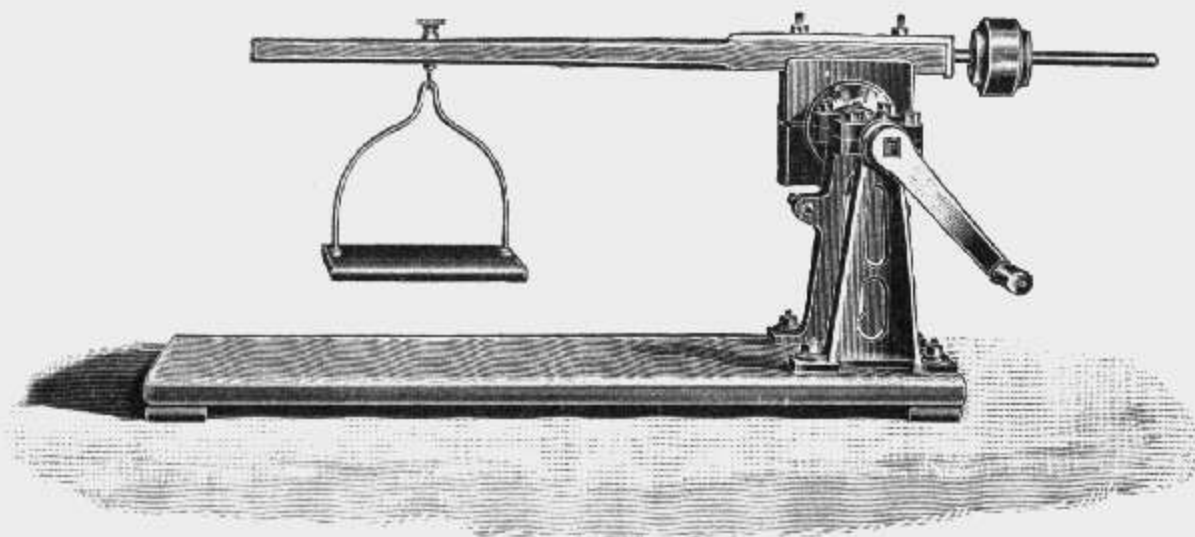
Nos

Francs



7360.

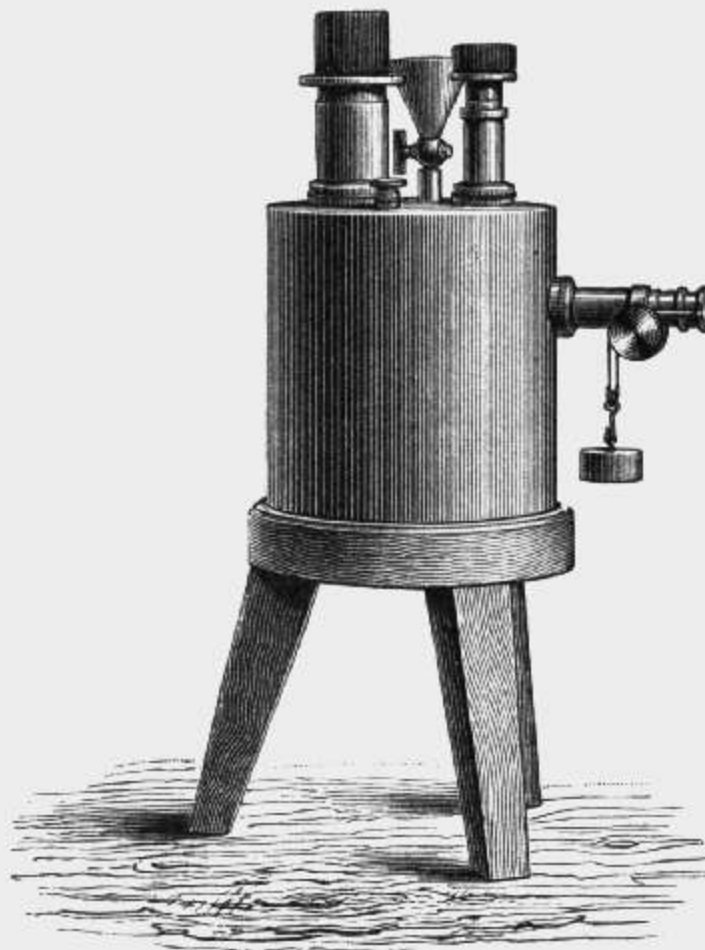
7370. **Model of Prony's Brake**, for the lecture-room, made of iron and wood (*fig.*) . . . . . 160
7380. **Leschot and Thury's Apparatus** to show that friction is suppressed by the interposition of a stratum of gas between the two rubbing surfaces. The apparatus is designed at the same time to study the lubricating power of different liquids (*fig.*) 500



7370.

§ 74. Hydrostatics.

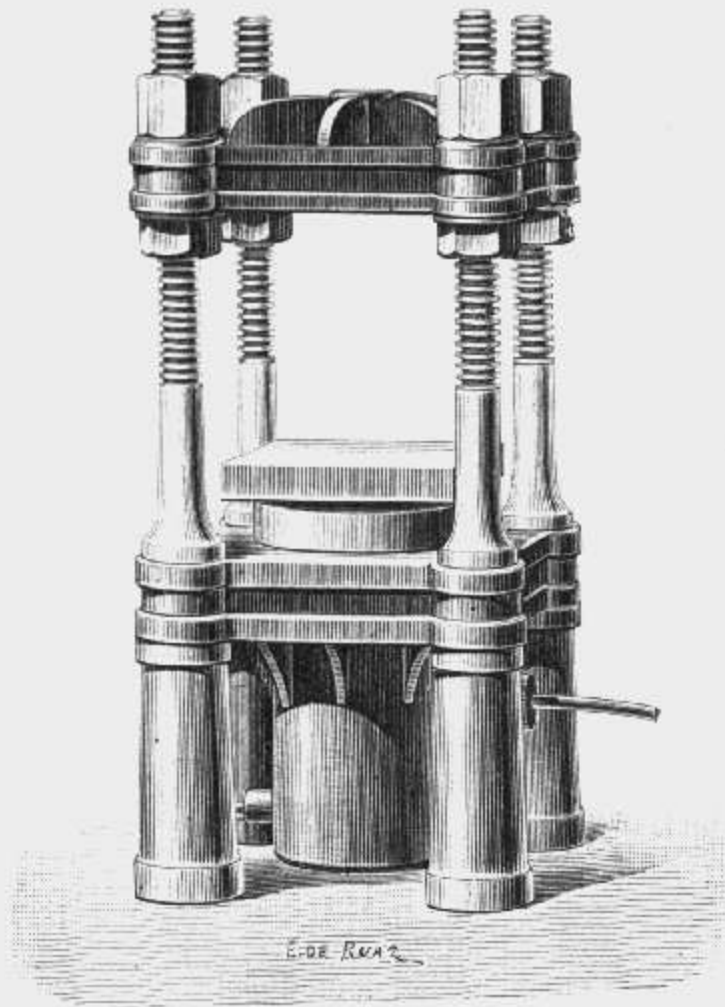
7400. **Hollow Brass Sphere**, pierced with capillary holes and adjusted on a small pump to prove that pressure in a liquid is communicated equally in all directions . . . . . 40
7405. **Apparatus for proving the preceding Principle** and especially that of *the Hydraulic Press*. Cylindrical copper reservoir 17 centim. in diameter, on which two pistons of different diameters are adjusted; a third piston is placed on the side of the cylinder. The pistons are provided with trays; equilibrium is obtained when each tray is loaded proportionally to its area (*fig.*) . . . . . 90



7405.

7406. **Do.** larger size; with four pistons; reservoir 22 centim. in diameter . . . . . 140
7410. **Apparatus** to show the pressure of liquids upwards from below . . . . . 12

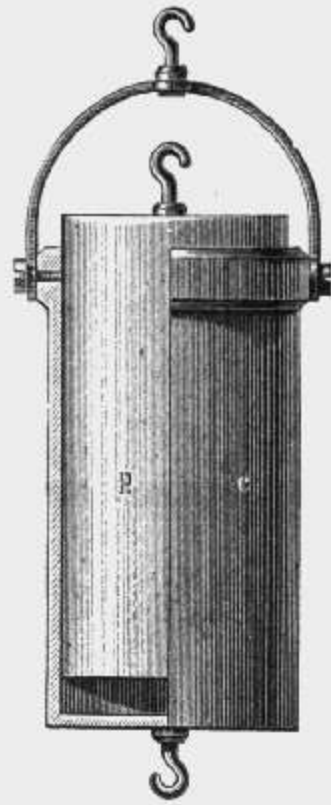
Nos	Francs.
7415. <b>Model of Hydraulic Press</b> for lectures; crystal-glass cylinder . . . . .	200
7420. <b>Hydraulic Press</b> , for use in laboratories. The apparatus is made to support a pressure of 300 atmospheres; the strain between the plates is about 10,000 kilograms . . . . .	600
7425. <b>Do.</b> the upper plate can be adjusted to suit the height of the object to be compressed ( <i>fig.</i> ) . . . . .	680



7425.

7430. <b>Haldat's Apparatus</b> with three large vessels of different shapes; the water's pressure is exerted on a column of mercury . . . . .	80
7435. <b>Do.</b> same apparatus of smaller dimensions; iron model serving also for showing the properties of connected tubes . . . . .	60
7440. <b>Pascal's Apparatus</b> , modified by <b>Masson</b> . — Three vessels of different shapes; the pressure of the water on the vessel's bottom attached to a balance is 1 kilogram . . . . .	70

Nos	Francs.
7444. <b>Pascal's Apparatus</b> , the pressure of the water being 500 grams . . . . .	60
7445. <b>Pascal's large Apparatus</b> . — The form and the dimensions are those of the earlier apparatus. The instrument is composed of a square metallic box resting on a tripod with levelling screws; two pistons and vessels of different shapes can be adjusted on the box in various positions. A balance-beam forming an integral part of the apparatus may be fastened to one of the pistons. Thus the pressure exerted on the piston by the water contained in the vessel can be estimated by weights . . . . .	200
7450. <b>Double cylinder</b> , to prove the <b>principle of Archimedes</b> . Volume equivalent to 100 grams of water ( <i>fig.</i> ) . . . . .	25



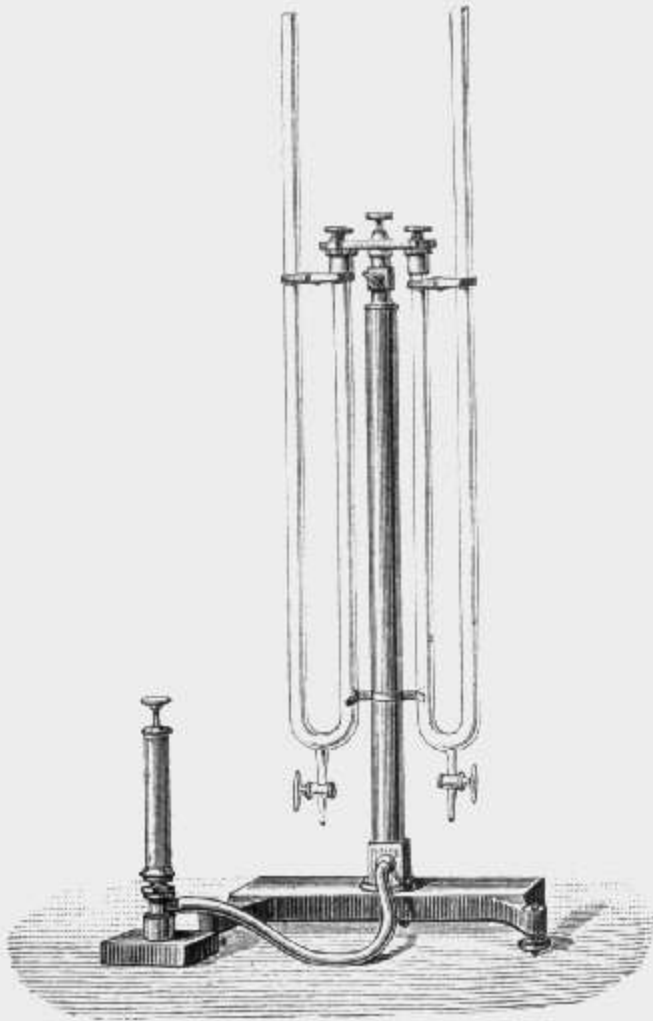
7450.

7455. <b>Nicholson's Areometer</b> , in brass and nickel . . . . .	22
7456. <b>Do.</b> in a box . . . . .	28
7460. <b>Double Column Areometer</b> , with pump to compare the density of liquids . . . . .	50
<b>Hydrostatic balances</b> (See <i>General measuring Instruments</i> , § 06).	

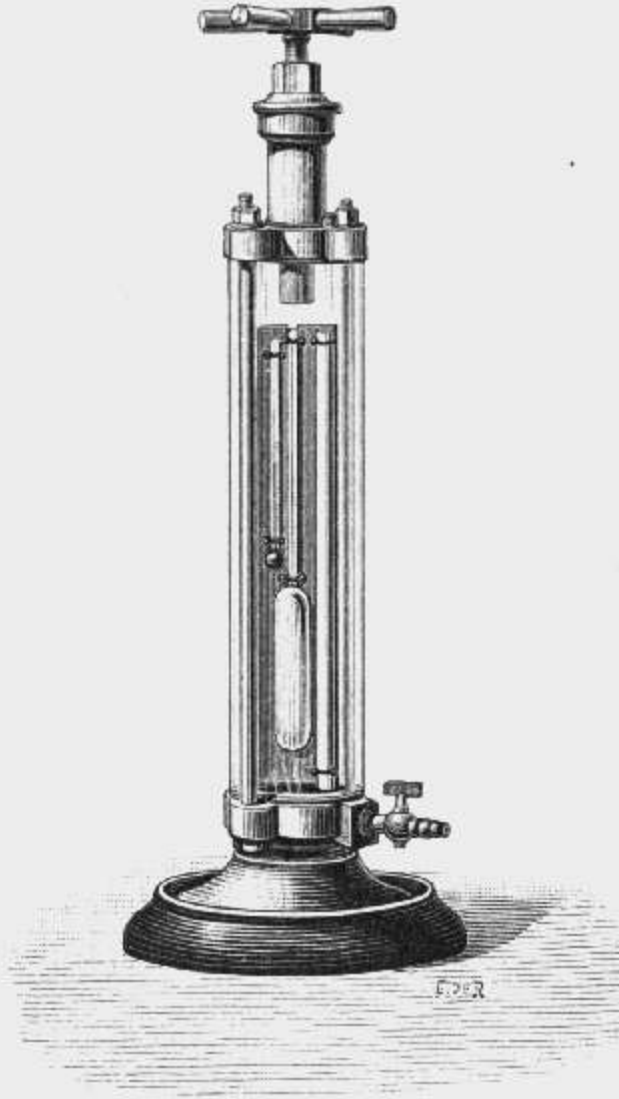
Nos

Francs.

7465. **Densimeter** with liquid columns, perfected by M. Thury. Reads by means of a cathetometer; errors of capillarity sensibly annulled. Tubes easily cleaned; measuring exact and rapid (*fig.*). See *Archives des Sciences*, Geneva, janv. 1893 . 150



7465.



7470.

7470. **Oerstedt's Piezometer**, cylindrical tube of strong-glass held by two rods between strong parts in bronze (*fig.*) . . . 90
7471. **Do.** larger size . . . . . 120
7475. **Regnault's Piezometer** with copper reservoir and brass basin . . . . . 160

§ 75. Hydrodynamics.

7500. **Plateau's Apparatus** to show the forms of cohesion of liquids. Glass-plates basin, 24 centim. each side . . . . . 200



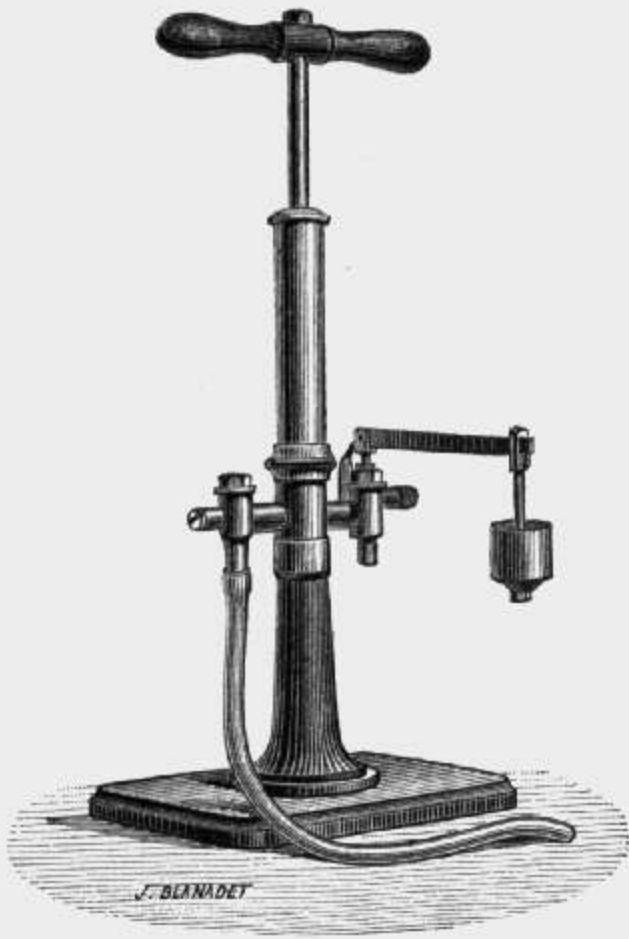
Nos		Francs.
7505.	<b>Apparatus to verify the Laws of flowing Liquids.</b> On a tripod; reservoir 15 centim. in diameter and 90 centim. high, widened at its upper part and provided with an overflow pipe. This reservoir has several holes, which can be easily closed. Four of these holes are equidistant and of the same size; three also of the same size, are placed at vertical distances in the ratio of 1, 2 and 3; three, whose diameters are to one another as the numbers 1, 2 and 3, are located in the same horizontal cross-section. A stop-cock in the lower part of the reservoir allows of adjusting a rubber tube . . . . .	120
7510.	<b>Do.</b> of larger dimensions and with Venturi's double cone . . . . .	220
7515.	<b>Paddle-Wheel</b> for measuring the speed of water at the surface . . . . .	90
7520.	<b>Hydraulic Swivel</b> , of brass . . . . .	40
7525.	<b>Woltmann's Moulinet</b> . . . . .	70
7530.	<b>Do.</b> covered with nickel; with the adjunction of a strong brass tube with steel ends serving to hold the moulinet at one extremity; at the other extremity a strong wooden rod can be adjusted. . . . .	100
7540.	<b>Héron's Fountain</b> , in glass and brass; height about 1 metre	90
7545.	<b>Water Hammer</b> , fall of water in vacuo . . . . .	6
7550.	<b>Model of Hydraulic Ram</b> . . . . .	150

## § 76. Compression Pumps

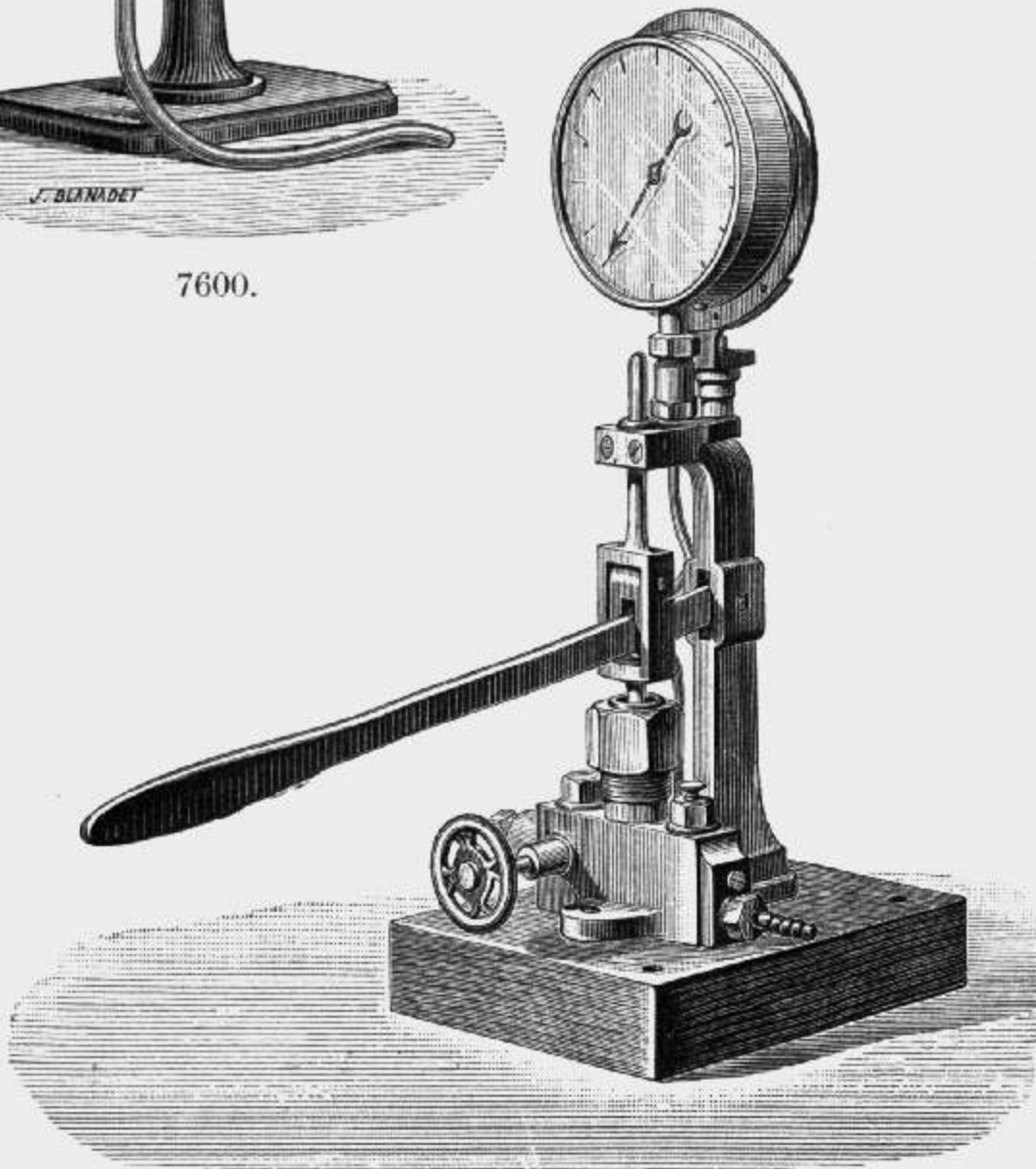
(for liquids or gases).

**Manometers** (See *General measuring Instruments*, § 07).

7600.	<b>Compression Pump</b> , for water, with plunging piston; can be used up to 30 atmospheres ( <i>fig.</i> ) . . . . .	130
7605.	<b>Do.</b> can be used up to 300 atmospheres ( <i>fig.</i> ) with manometer . . . . .	350

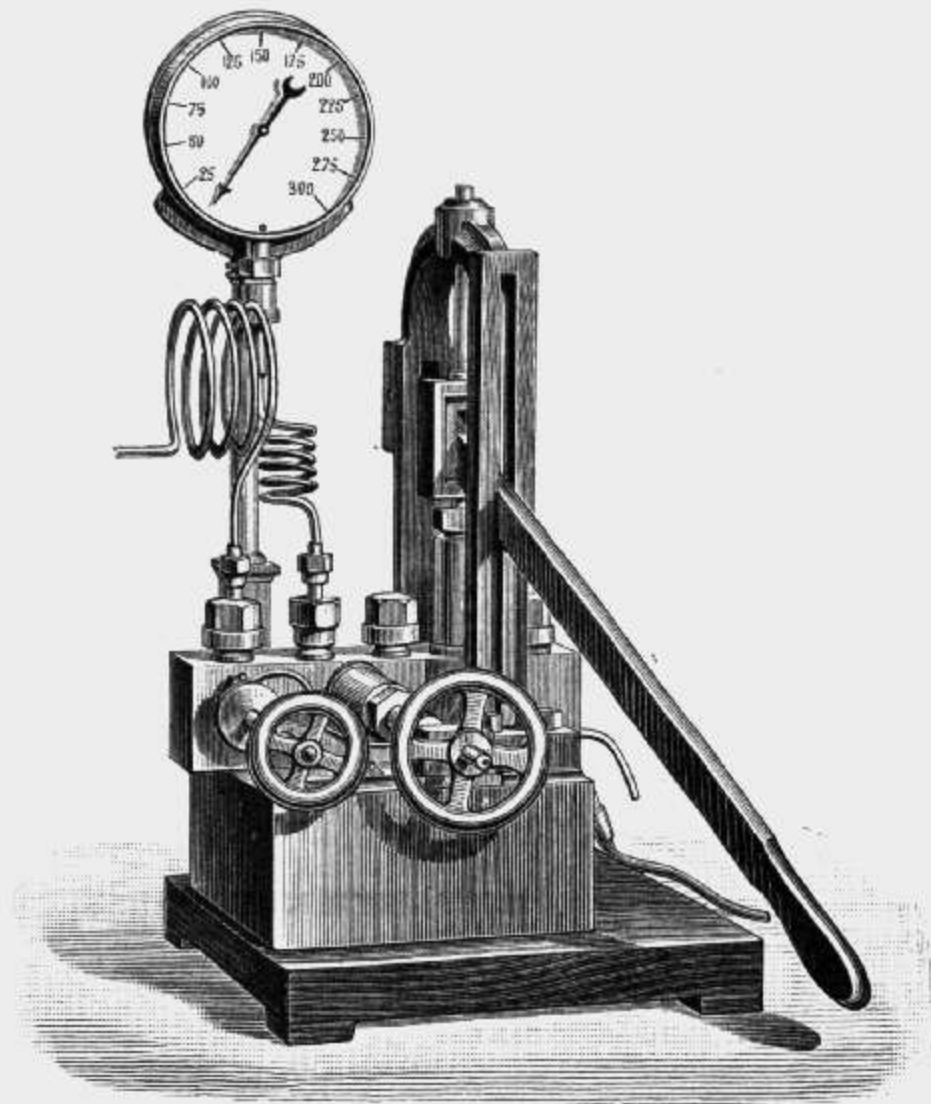


7600.



7605.

Nos		Francs.
7606.	<b>Compression Pump</b> , like the preceding but without manometer . . . . .	270
7610.	<b>Do.</b> more complete model, permitting, the gradual application of strong pressures by means of a screw ; with manometer for 300 atmospheres ( <i>fig.</i> ) . . . . .	500

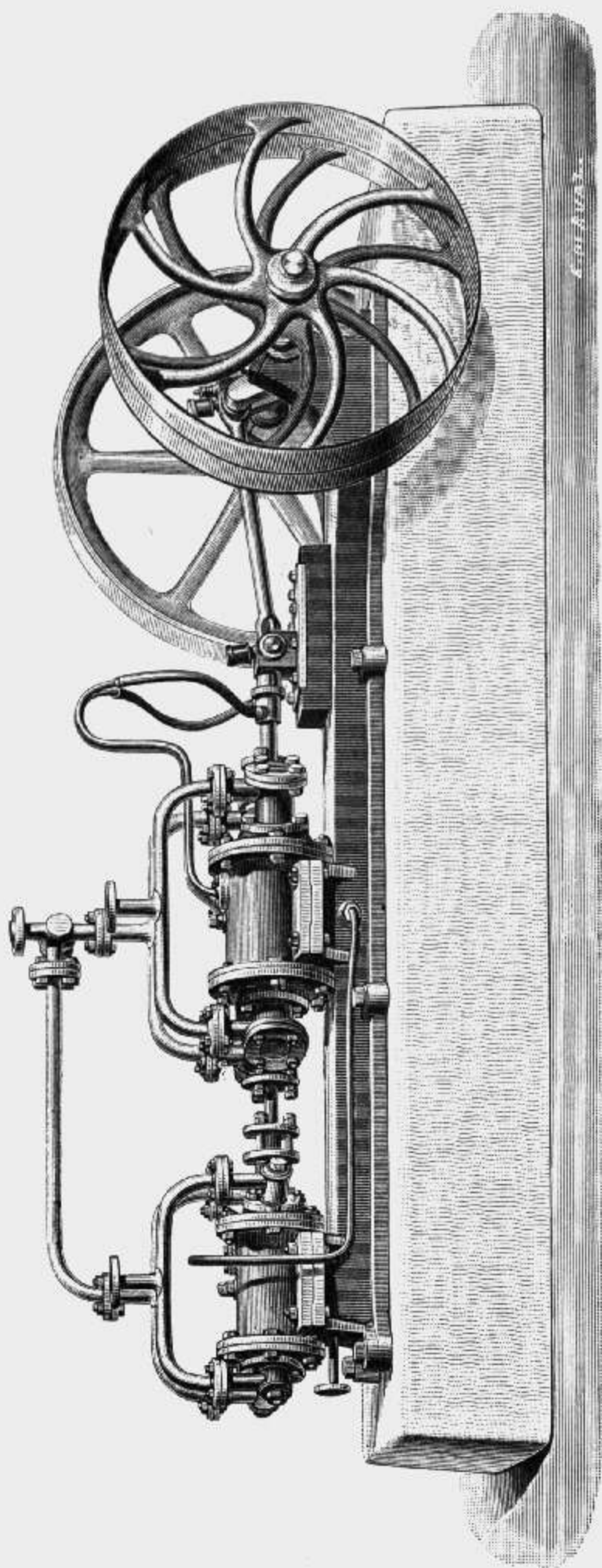


7610.

7615.	<b>Do.</b> constructed for pressures up to 1000 atmospheres . . . . .	600
-------	---	-----

### **Compression Pump for Air and Gases.**

The introduction, into large laboratories of physics, of motors designed for various apparatus requiring a considerable force, such as dynamos, &c. permits also the compressing of air or gases on a much larger scale than formerly.



7640.

Nos

Francs.

A compression pump must be so constructed as to suppress all heating adverse to its action. This heating arises from the very work of compressing the gas.

In 1872, Prof. Colladon began to construct, in our Works, the first compression pump of the system bearing his name. On this model enlarged, other compressors were constructed, which were used to bore the Gothard and many other tunnels.

The air or gases are cooled during the compression by a circulation of cold water round the cylinder, in the piston rod and in the piston itself.

Up to about 10 atmospheres, the compression of air and gases is sufficiently productive with a single compressing cylinder. Beyond this pressure up to 30 atmospheres, two compound cylinders, are employed, one compressing the other. (See figure 7640). Above 30 or 40 atmospheres it is preferable to have a triple compression.

### Single Compressors.

	Volume generated by each revolution in liters		Diameter of piston in millim.	Path of Piston in millim.		
7620.	1.50		90	120	. . . . .	1650
7625.	3.20		105	200	. . . . .	2090
7630.	4.00		115	200	. . . . .	2420
7635.	6.00		140	200	. . . . .	2860

### Conjugate Compressors, on a same framework (fig.)

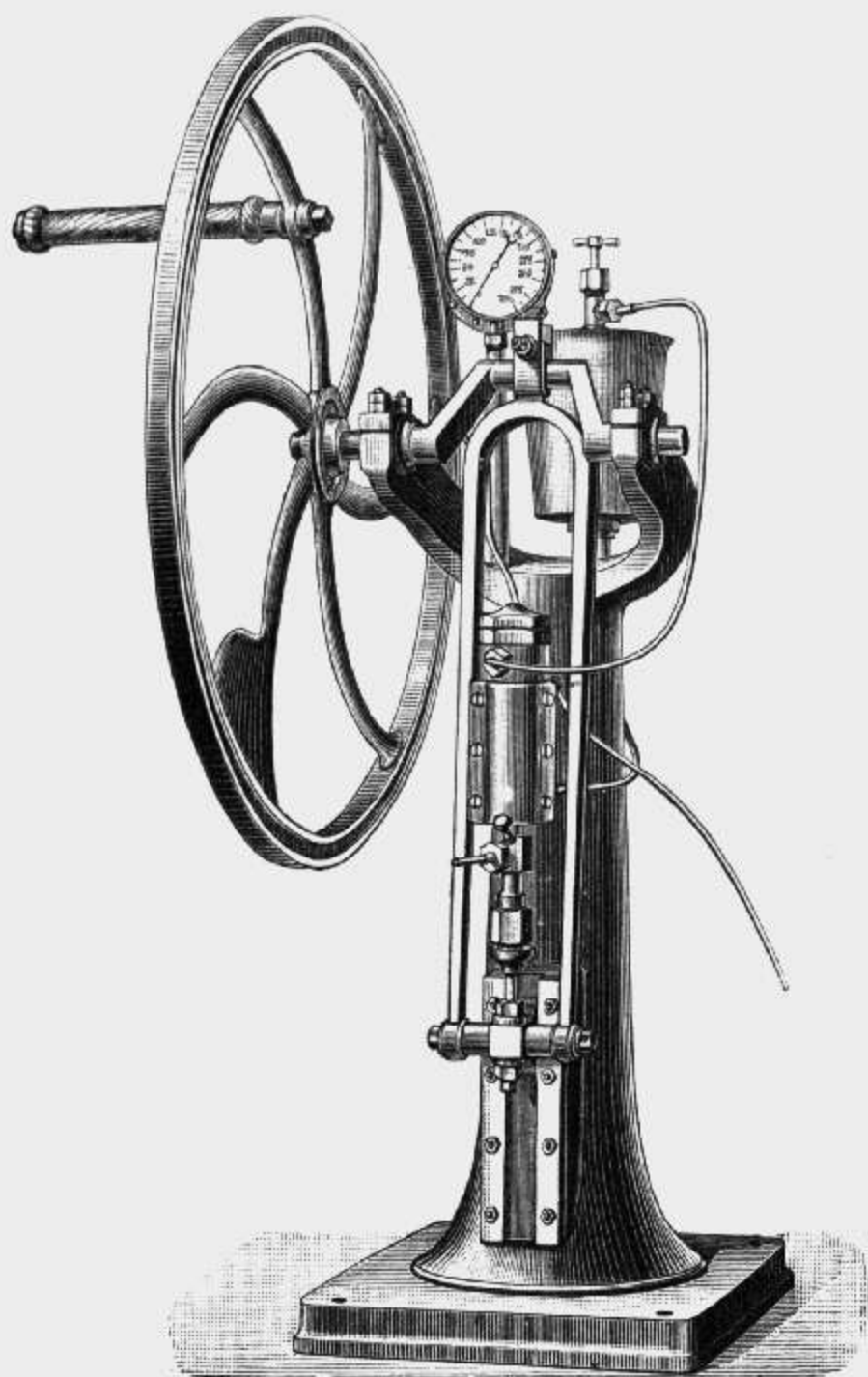
	Volume generated each revolution in liters		Diameter of pistons in millimetres		Path common to the pistons	
	Large cyl.	Small cyl.	Large cyl.	Small cyl.		
7640.	4.00	1.20	116	65	200 . . . .	2970
7645.	10	2.50	182	94	200 . . . .	4140

7650. **Gas Compression Pump.** Apparatus replacing advantageously the former pump known as Natterer's pump. Piston 16 millim. in diameter, path 25 centim. ; reservoir 200 cubic centim. capacity, tested for a pressure of 200 atmospheres (fig.). 1260

Nos

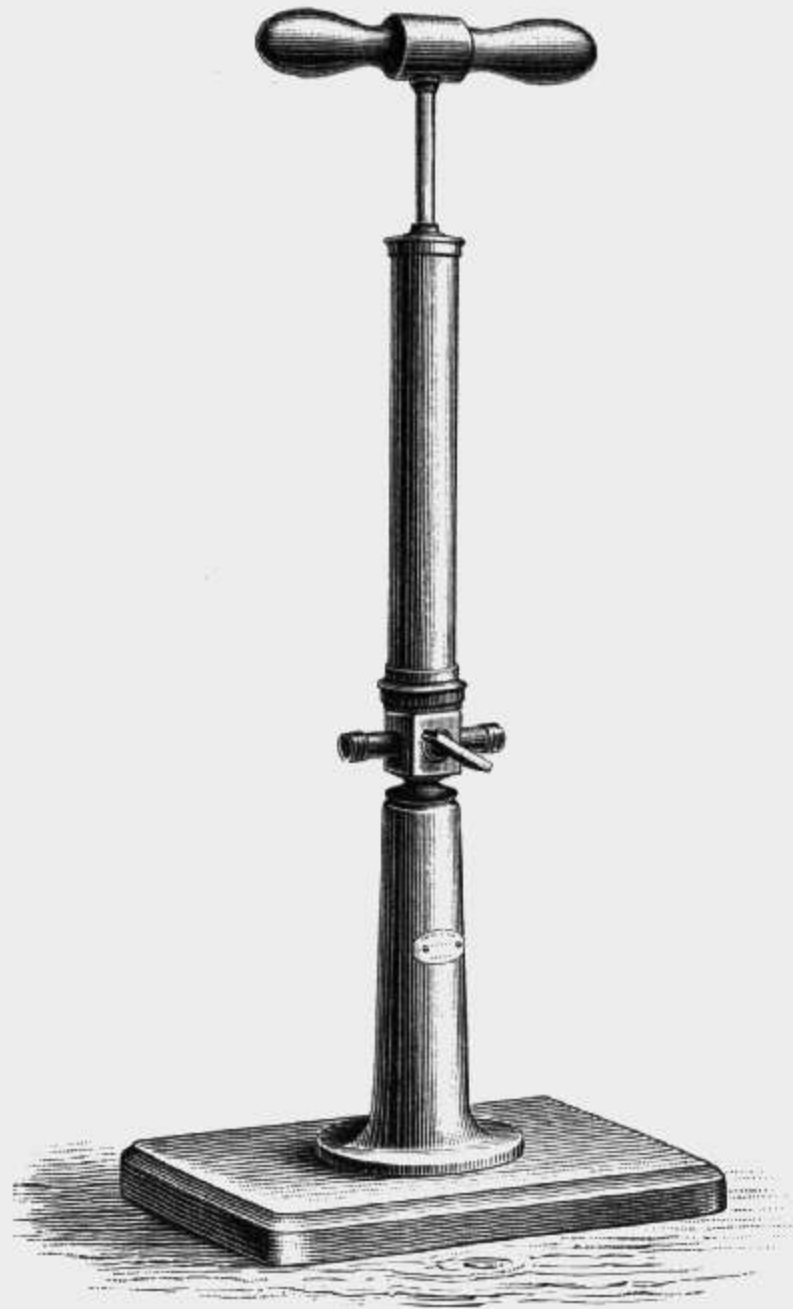
Francs.

7660. **Double-action Hand Pump**; industrial model, of very strong make, producing a vacuum of 20 to 25 millim. . . . 75



7650.

7665. **Regnault's Hand Pump**, double action. A central cock enables one to reverse the action of the valves or to establish a direct communication between two vessels or with the outside; making a vacuum of 10 millim. (*fig.*) . . . . . 95



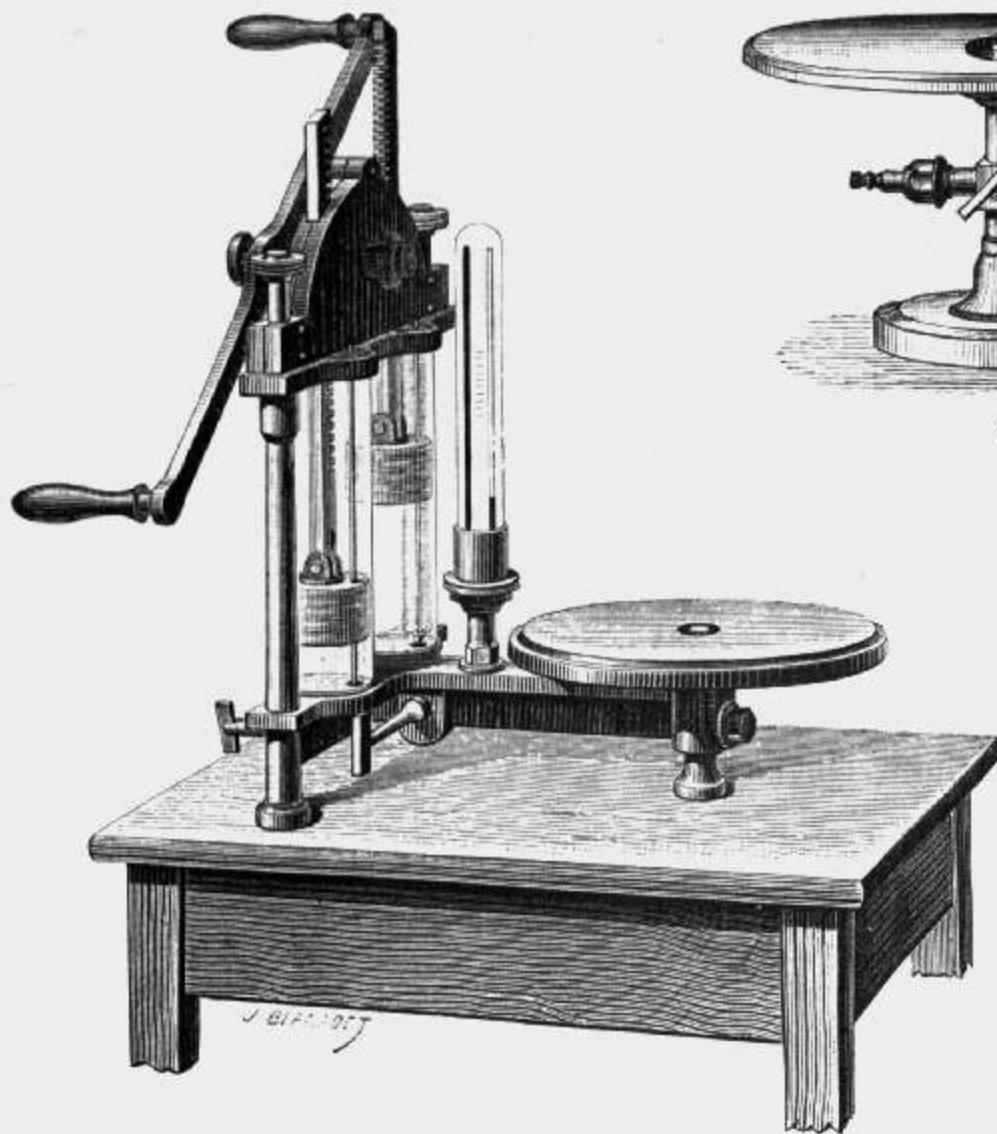
7665.

### § 77. Pneumatic Machine and Accessories.

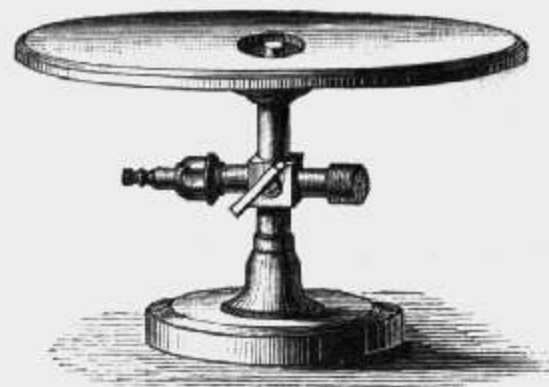
- |       |   |     |
|-------|---|-----|
| 7700. | <b>Double Cylinder pneumatic Pump</b> of crystal-glass, 55 millim. inside diameter; plate 270 millim. in diameter; Babinet's stop-cock ( <i>fig.</i> ) . . . . .                  | 500 |
| 7705. | <b>Do.</b> of crystal-glass, 65 millim. inside diameter; plate 270 millim. in diameter; Babinet's stop-cock . . . . .   | 550 |
| 7710. | <b>Bianchi's pneumatic Machine</b> , rotatory, oscillating crystal cylinder, 90 millim. inside diameter; Babinet's stop-cock. Independent plate and truncated manometer . . . . . | 800 |

Nos

Francs.



7700.



7720.

**Independent Plates** for pneumatic pumps. Plate of glass, metal mounting; three way cock for making connections (*fig.*).

	Diameter of the plate.	Cast-iron plate, brass stop-cock.	Cast-iron plate, steel stop-cock.
7720.	32 centim.	Fr. 60	Fr. 70
7722.	30 »	» 55	» 65
7724.	28 »	» 50	» 60
7726.	26 »	» 45	» 55
7728.	24 »	» 40	» 50
7730.	22 »	» 35	» 45

7740. **Complete Column Barometer** for measuring with precision the degree of rarefaction in pneumatic apparatus; see nos 0720 and following.



Nos	Francs.
7750. <b>Crève-vessie.</b> . . . . .	3 to 4.50
7755. <b>Leslie's Apparatus,</b> for freezing in vacuo . . . . .	12
7760. <b>Pluie de Mercure</b> (Mercury rain) to show the porosity of wood. Placed directly on the plate of a pneumatic pump .	30
7765. <b>Double Moulinet,</b> showing the resistance of the air, can be used under the bell of a pneumatic pump . . . . .	40
7770. <b>Jet of Water in vacuo</b> . . . . .	30
7775. <b>Rubber, Lead or soft Copper Tube</b> for connecting the parts of pneumatic machines, 120 centim. long, screw- nuts and adjusting pieces at both extremities . . . . .	10
<b>Tubes for falling bodies</b> (See <i>Laws of Gravity</i> , § 72).	
7780. <b>Crystal Bells,</b> with knob and close fitting edge. Price ac- cording to the weight and size . . . . .	4 to 25
7785. <b>Turn-cock Bracket</b> for screwing on pneumatic receivers .	10
7790. <b>Leather Box</b> with movable stem screwing on the bracketed pneumatic receivers . . . . .	15
7795. <b>Bladder with Turn-cock.</b> . . . . .	5

### § 78. Atmospheric Pressure.

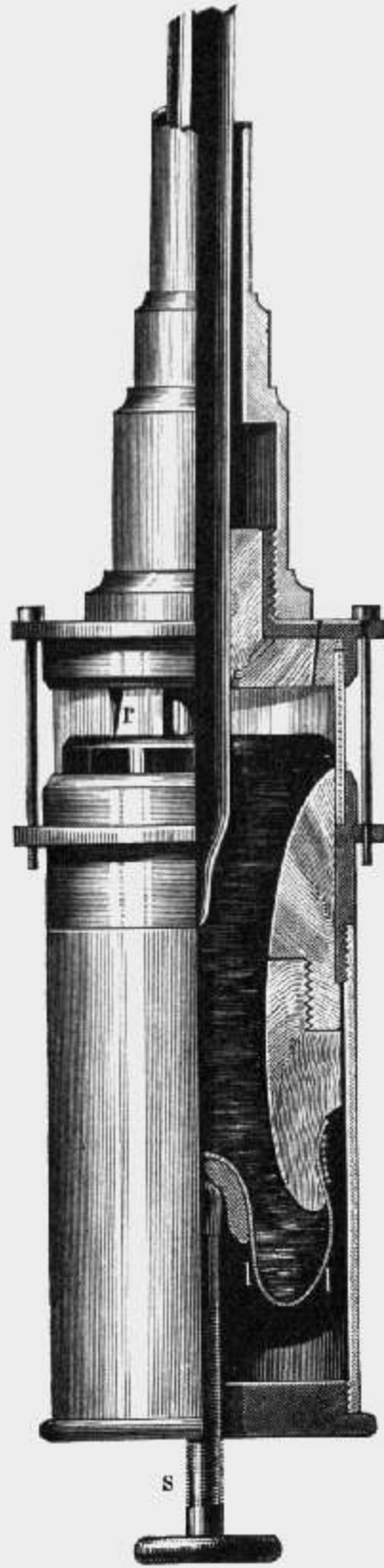
7800. <b>Magdeburg Hemispheres,</b> small model . . . . .	28
7801. <b>Do.</b> large model . . . . .	38
7810. <b>Recipient</b> with two barometers showing the atmospheric pressure . . . . .	40
7820. <b>Glass Globe with Stop-cock</b> for showing experimen- tally the weight of air; about 3 litres capacity . . . . .	16
7830. <b>Baroscope</b> . . . . .	40
7835. <b>Baroscope,</b> Prof. Schoentjes's. Two hollow brass cylinders telescoping into each other, and a hook for suspending them from the beam of scales . . . . .	40

**Barometers** (See also *Meteorology*, Chap. 6, § 62.)

Nos

Francs.

7850. **Library Barometer**, Fortin's system, glass bowl, cast-iron mounting, millimetric scale with rack and pinion, vernier



7860.

reading to  $\frac{1}{10}$  millim. Column of quicksilver 9 millim. in diameter, thermometer and suspension hooks . . . . . 120

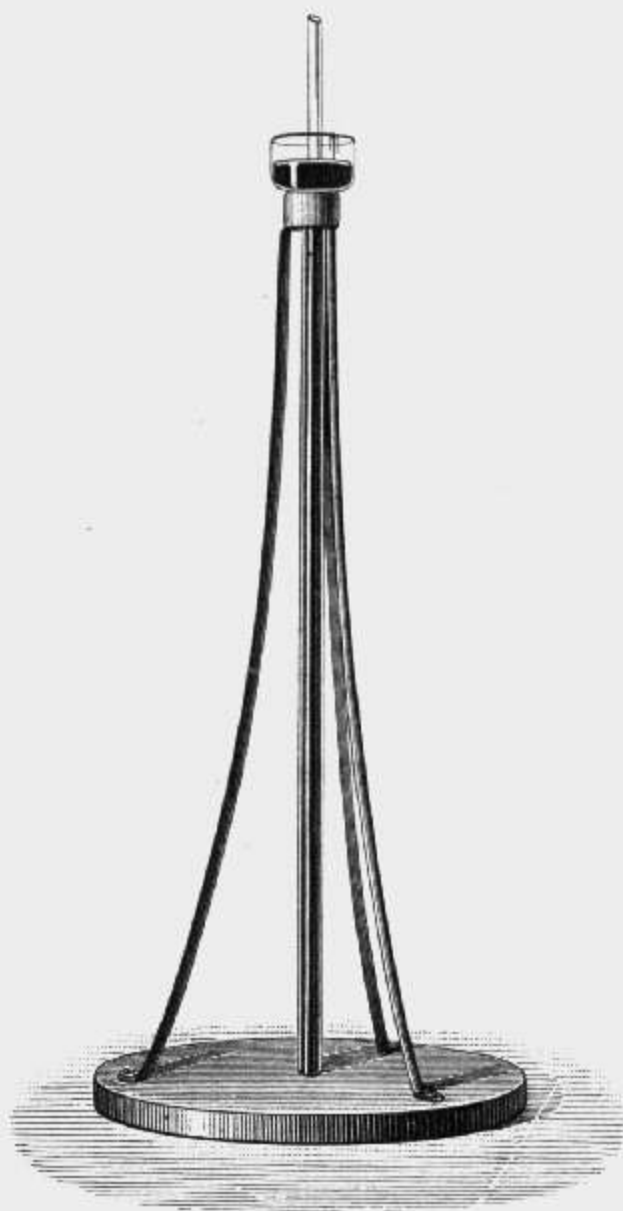
7860. **Fortin's Bowl for Barometer**, showing its different parts (*fig.*) . . . . . 40

### § 79. Equilibrium and Movement of Gases.

**Manometers** (See *General Measuring Instruments*, § 07).

**Mariotte's Apparatus**, see n° 0700.

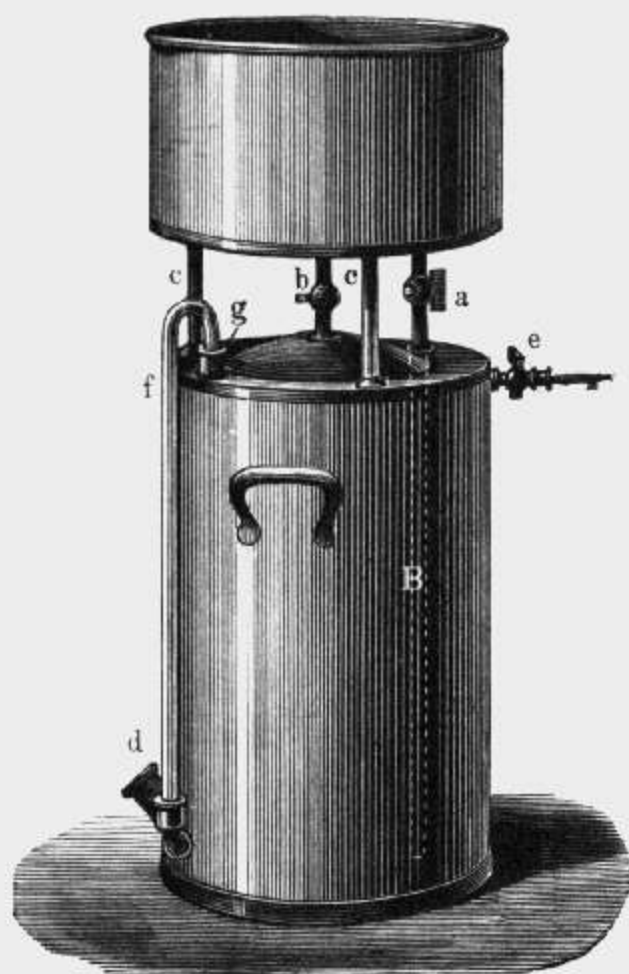
7900. **Barometer with deep bowl** to show that Mariotte's law applies to non saturated vapours and to gases when submitted to pressures less than the atmospheric pressure (*fig.*) . 30



7900.

7905. **Barometer with deep bowl**; the barometric tube is divided its whole length and the apparatus is provided with a movable index . . . . . 50

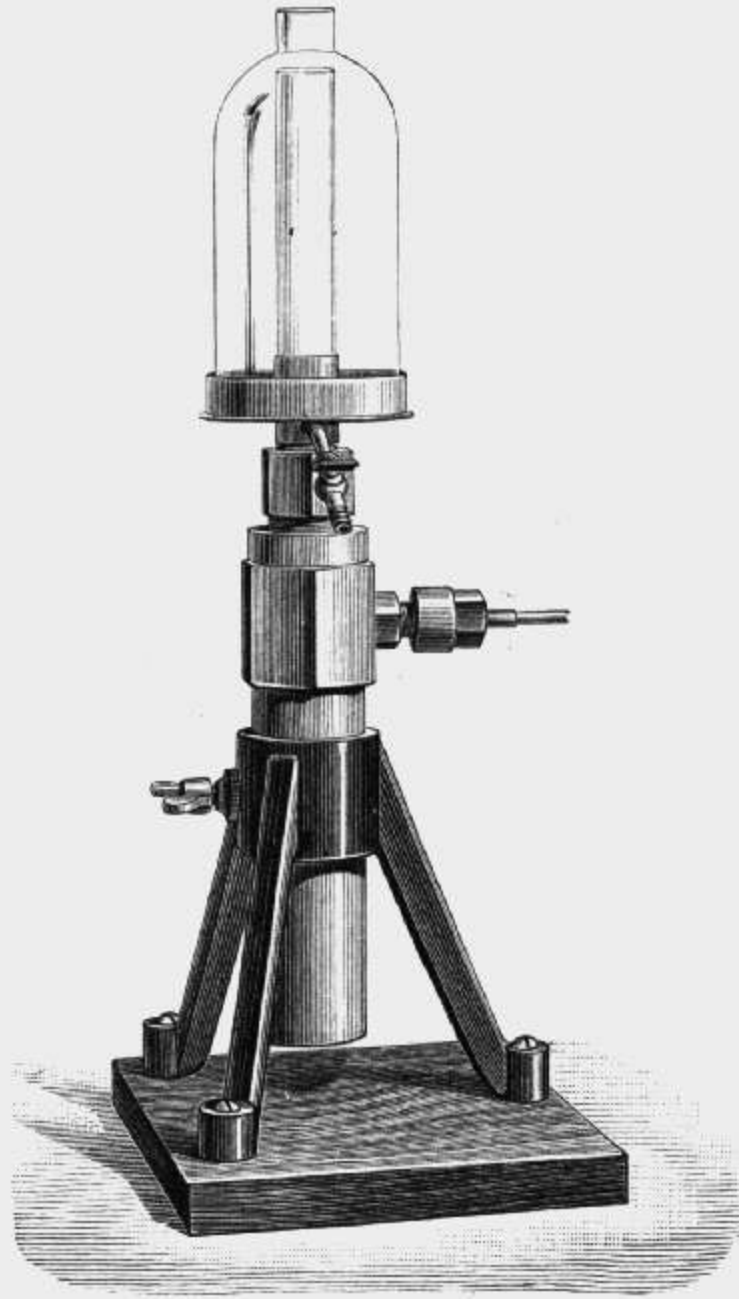
Nos		Francs.
7910.	<b>Barometer with wide bowl and four tubes</b> for showing the difference of tension of various vapours . . . .	50
7915.	<b>Two balloons of 8 and 10 litres capacity</b> with stop-cocks, to determine the specific weight of gases . . . .	60
7920.	<b>Mitscherlich's Gasometer</b> , small size 15 liters capacity, of brass . . . . .	60
7925.	<b>Do.</b> 35 liters capacity, of red copper or brass (fig.) . . . . .	130



7925.

7930.	<b>Gasometer</b> , with floating and equilibrated receiver of 50 litres capacity and upwards, according to the size . . . . .	150 to 300
7935.	<b>Single Aspirator</b> 10 litres capacity . . . . .	35
7936.	<b>Do.</b> 25 litres capacity . . . . .	55
7940.	<b>Double Aspirator</b> , 10 litres capacity . . . . .	65
7945.	<b>Pneumatic Briquet</b> of crystal-glass . . . . .	25

Nos	Francs.
7950. <b>Cailletet's Apparatus</b> for the demonstration of the laws of liquefaction of gases under a pressure of 300 atmospheres; the apparatus is composed of the compression pump ( <i>fig. 7610</i> ) and a steel recipient as devised by Cailletet ( <i>fig.</i> ) . . . . .	650



7950.

7955. <b>Do.</b> The same apparatus constructed to stand pressures up to 1000 atmospheres . . . . .	800
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7960. <b>Steam Swivel</b> . . . . .	40
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**Anemometers.** (See *Meteorology*, Chap. 6, § 63.)

## CHAPTER 8

### TECHNICAL MECHANICS

(Classification by Reuleaux.)

- § 80. Lower couples of Elements.
- 81. Plane Mechanisms composed of lower Couples of Elements.
- 82. Spherical Mechanisms composed of lower Couples of Elements.
- 83. Higher Couples of Elements.
- 84. Mechanisms composed of higher Couples of Elements.
- 85. Coupling and Uncoupling.
- 86. Mechanisms composed of ductile Elements.
- 87. Machines with ductile Parts.
- 88. Hydraulic Mechanisms and Machines.
- 89. Steam-Engines.

N<sup>os</sup>

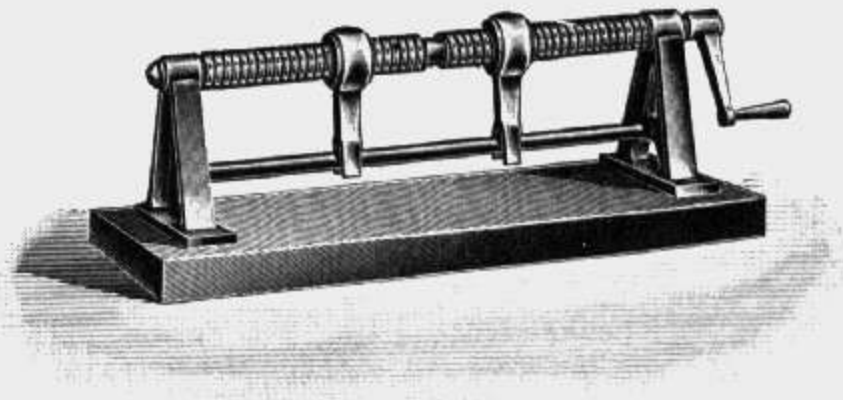
Francs.

### § 80. Lower Couples of Elements

(called *close fitting couples*: **prisms, cylindrical sockets, screws.**)

- 8000. **Couple formed by Two Prisms** of wood sliding one into the other . . . . . 10
- 8005. **Rectilinear Groove** of wood with cursor sliding in the groove . . . . . 12
- 8010. **Couple formed by two surfaces of revolution** fitting exactly into each other. Wooden model . . . . . 15

Nos	Francs.
8015. <b>Circular Groove</b> (incomplete socket) of wood with circular cursor sliding in the groove. . . . .	15
8020. <b>Couple formed by a screw and its nut.</b> Wooden model . . . . .	15
8030. <b>Wooden Cylinder;</b> a triangular sheet of waxed paper is wound round the cylinder to show the <i>development of the helix or screw</i> . . . . .	7
8040. <b>Screw</b> with opposed threads, mounted with nuts ( <i>fig.</i> ). . . . .	65



8040.

8050. <b>Screw</b> with differential threads, mounted with nuts . . . . .	65
8060. <b>Screw</b> with four different threads . . . . .	25

## § 81. Plane Mechanisms composed of lower Couples of Elements.

(Plane Linkages, Sliders, &c.)

See «*Cinématique*» of Reuleaux, Paris 1877, p. 345.

### Quadrilateral Link Motion.

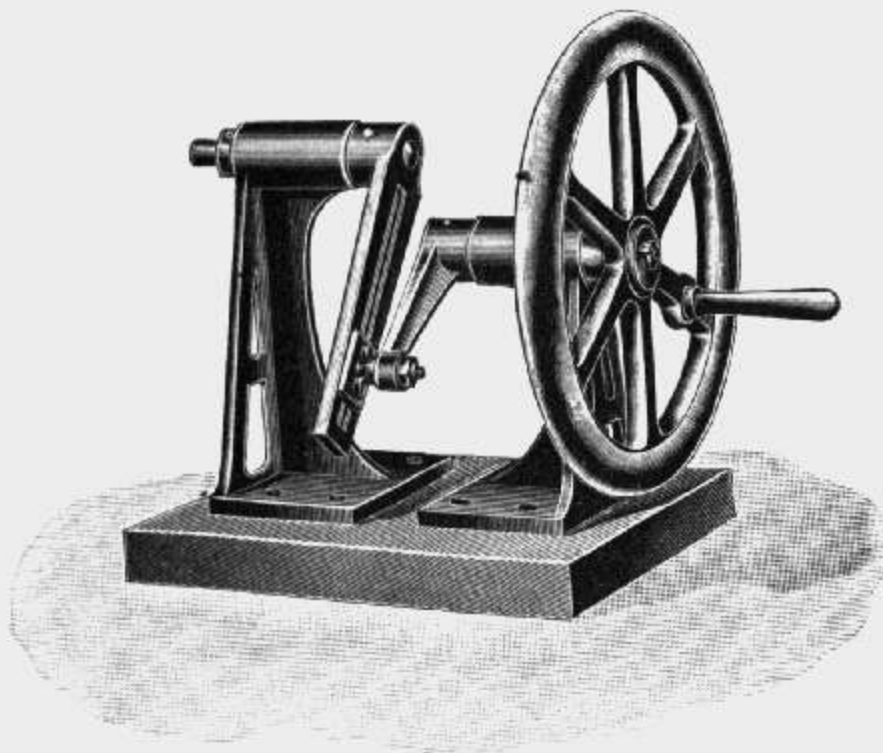
8100. A revolving crank driving an oscillating crank. . . . .	100
8101. Two revolving cranks coupled. . . . .	100
8102. Two oscillating cranks coupled . . . . .	100
8103. Parallel cranks coupled (two cranks of equal radii) . . . . .	100
8104. Antiparallel cranks coupled in opposite directions . . . . .	105
8105. Do. do. in the same direction . . . . .	105

Nos

Francs.

**Driving Crank kinematic Chain.**

8110.	Driving crank, connecting rod and cross-head guide . . . . .	105
8111.	Eccentric, connecting rod and cross-head guide. . . . .	105
8112.	Revolving Crank and oscillating cylinder . . . . .	100
8113.	Crank and rotating slider (two coupled cranks of which one is with a slide) increasing and decreasing alternately the angular velocity ( <i>fig.</i> ) . . . . .	90
8114.	Oscillating driving crank, connecting rod and cross-head guide.	100

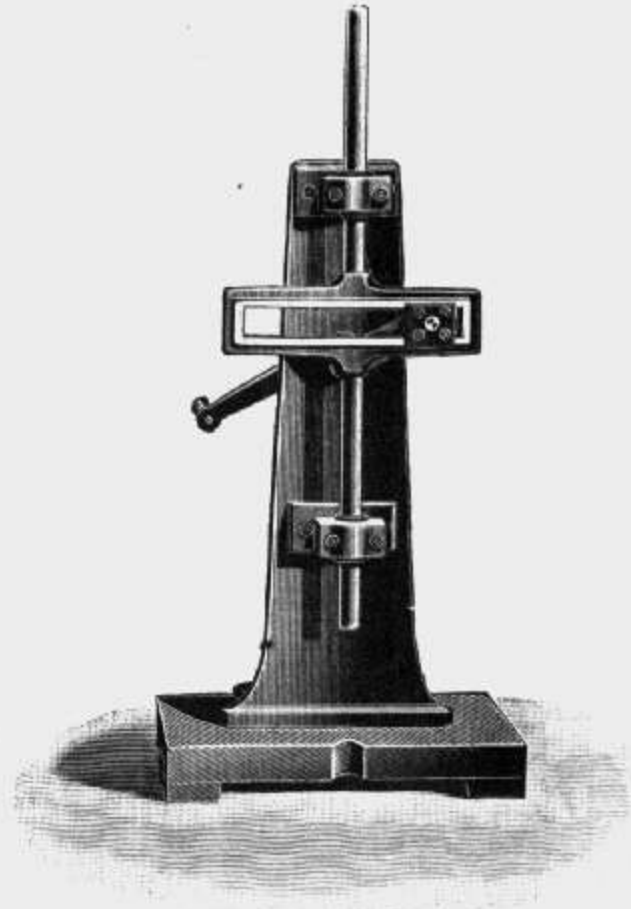


8113.

**Cross Slot kinematic Chain.**

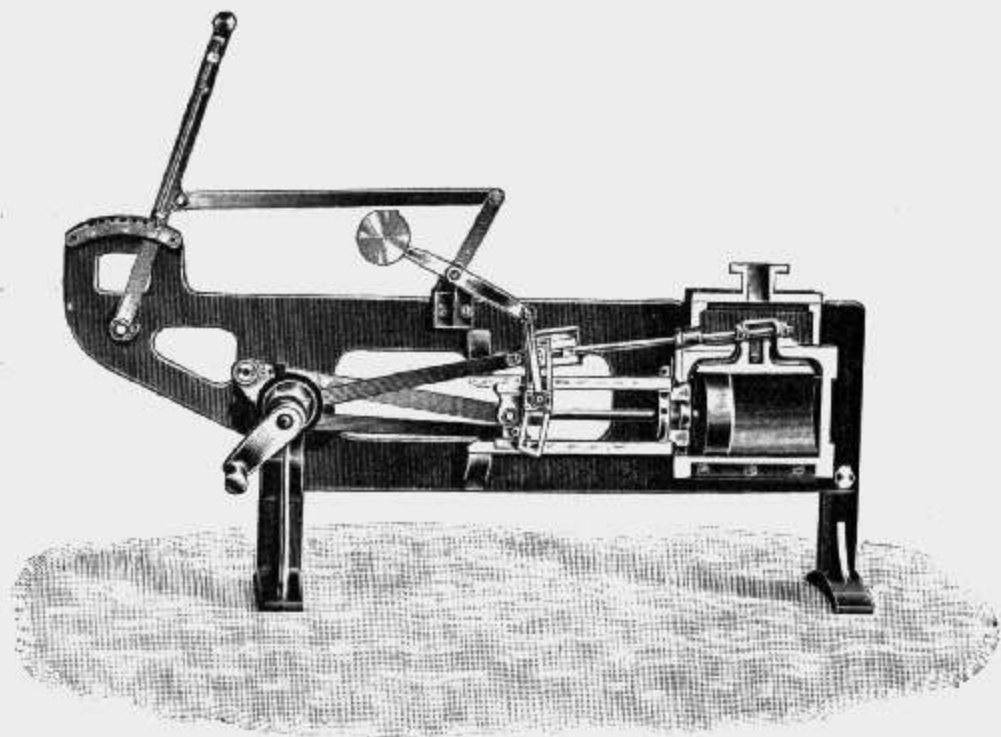
8120.	Rotating crank and oscillating cross slot ( <i>fig.</i> ) . . . . .	100
8121.	Rotating cross slot and fixed crank . . . . .	105
8122.	Crossed slot fixed and oscillating crank . . . . .	100
8123.	Oscillating cross slot and rotating crank. . . . .	100
8130.	<b>Oldham Joint</b> (rotating cross slot) used for coupling two parallel axes. The ratio of the angular velocities is constant and equal to one . . . . .	100
8150.	<b>Peaucellier's Link Motion</b> for transforming a circular motion into a rectilinear motion or more generally for any plane transformation by reciprocal radii-vectores . . . . .	160





8120.

8155. <b>Watt's Parallel Motion</b>	. . . . .	200
8160. <b>Stephenson's Link-Motion, of iron</b> ( <i>fig.</i> )	. . . . .	300



8160.

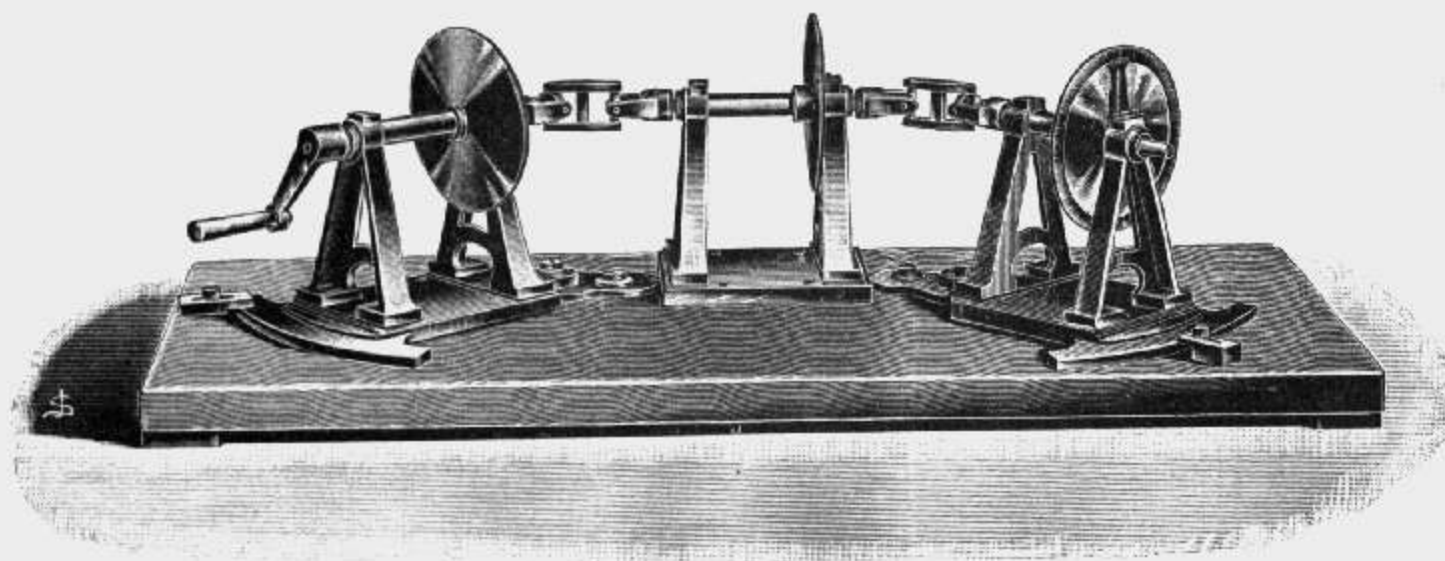
Nos	Francs.
8165. <b>Gooch's Link-Motion</b> , of iron . . . . .	300

**§ 82. Spherical Mechanisms composed of lower Couples of Elements.**

(Spherical linkages, spherical sliders, etc.)

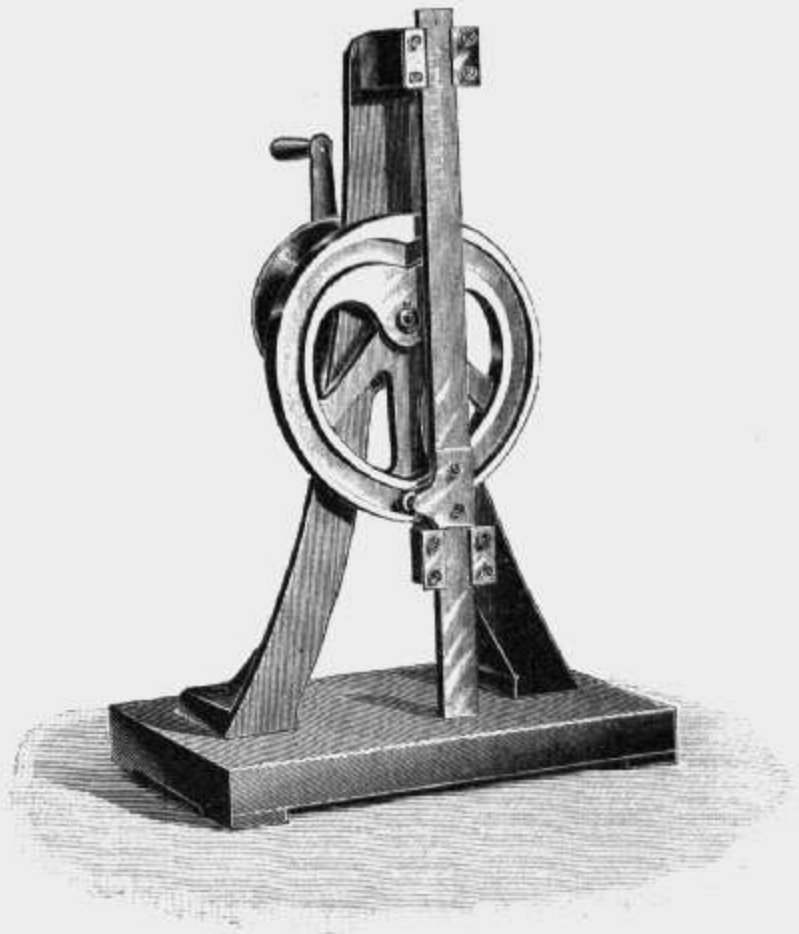
See «*Cinématique*» of Reuleaux, p. 348.

8200. <b>Spherical quadrilateral Link-Motion</b> (spherical cranks coupled) . . . . .	160
8210. <b>Kinematic Chain of conical Driving Crank</b> (spherical connecting rod and cross-head guide) . . . . .	160
8220. <b>Kinematic Chain of rectangular Cross Joint</b> (simultaneous rotation of a sphere round two axes). . . . .	160
8230. <b>Cardan or Hook's Universal Joint</b> with graduated dials showing that the ratio of the angular velocities of the two axes is not constant ( <i>fig.</i> ) . . . . .	110

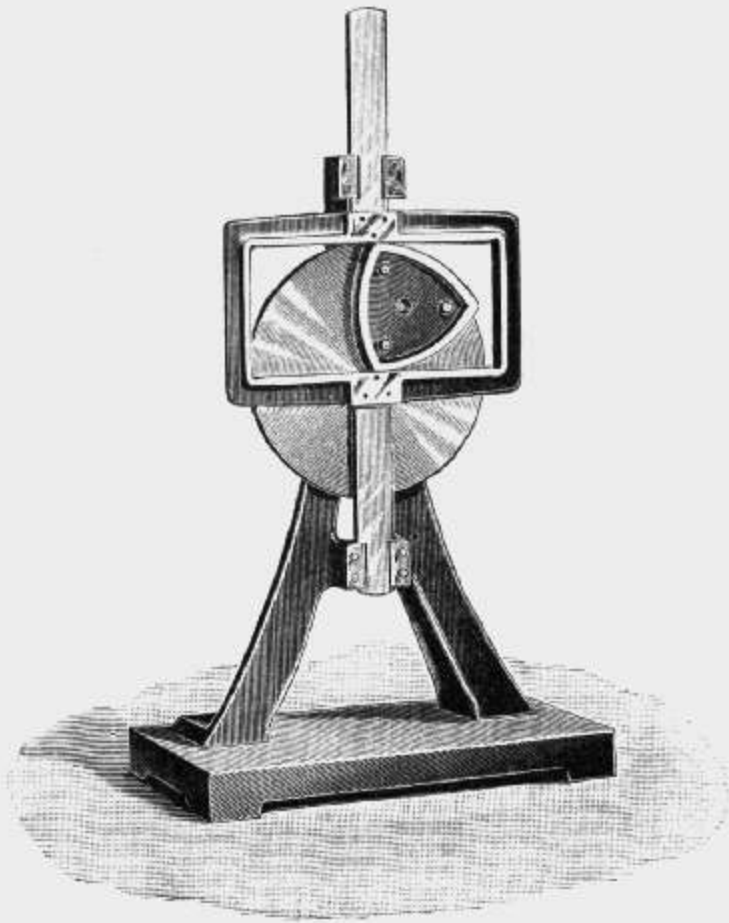


8230.

8240. <b>Goubet's Joint</b> , or double universal joint, with coupling-box. The ratio of the angular velocities of the axes is constant. . . . .	160
8250. <b>Clemens' Joint</b> , with spherical ball and socket joints. The ratio of the angular velocities is constant . . . . .	200



8302.



8303.

Nos

Francs.

**§ 83. Higher Couples of Elements.  
(Cams, Toothed Wheels, etc.)**

**Cams and Guides**, for transforming a circular motion into an alternative rectilinear motion.

8300. Eccentric Groove . . . . .	140
8301. Eccentric cam with variable eccentricity. . . . .	160
8302. Heart shaped cam, for uniform motion ( <i>fig.</i> ) . . . . .	100
8303. Triangular cam, for intermitting motion ( <i>fig.</i> ) . . . . .	105
8304. Cam for motion according to the law of the sine . . . . .	100

**Spur-Gearing** to transmit motion between two parallel axes :

8320. Two wheels with teeth on the outside . . . . .	60
8321. Wheel toothed on the outside and wheel toothed on the inside .	75
8322. Rack and pinion . . . . .	60
8323. Two wheels with teeth on the outside ; various shapes of teeth .	120
8330. Spur and lantern-wheel, wooden model . . . . .	75
8331. Tapered spur-gearing to diminish friction . . . . .	120
8332. Helicoidal spur-gearing or Hook's frictionless gearing . . . .	150
8340. Two toothed wheels with eccentric axes . . . . .	100
8341. Two non circular toothed wheels, different forms. . . . .	120
8342. Two elliptical toothed wheels . . . . .	130
8343. Two logarithmic spiral toothed wheels . . . . .	150

**Bevel Gearing** for the transmission of motion between two intersecting axes :

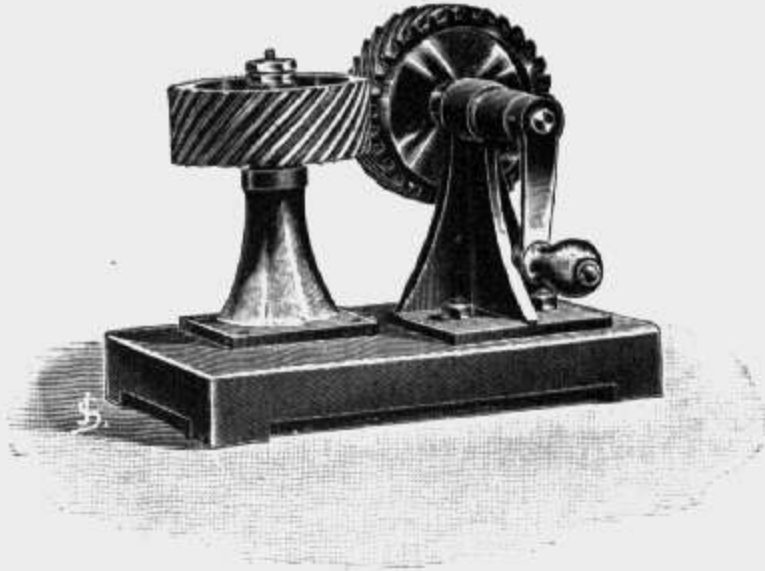
8350. Two toothed wheels, whose axes intersect at right angle. . .	70
8351. Two toothed wheels, whose axes form an obtuse angle . . . .	70

Nos

Francs.

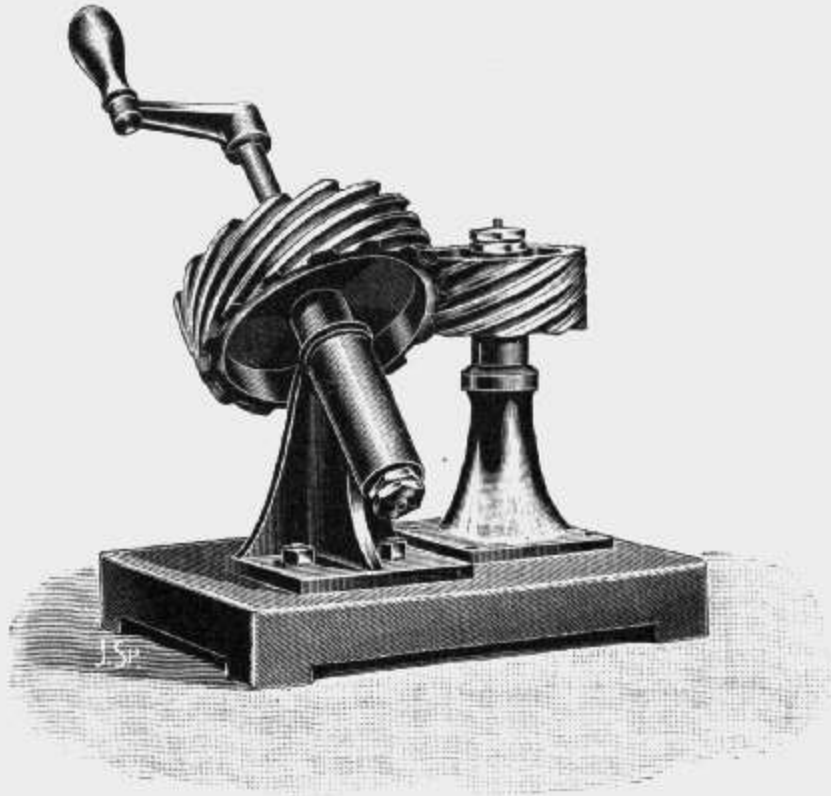
**Helicoidal Gearing** for the transmission of motion between two axes which do not intersect :

- 8360. Two wheels with helicoidal teeth, whose axes are perpendicular to each other (*fig.*) . . . . . 130



8360.

- 8361. Do. with oblique axes (*fig.*) . . . . . 150



8361.

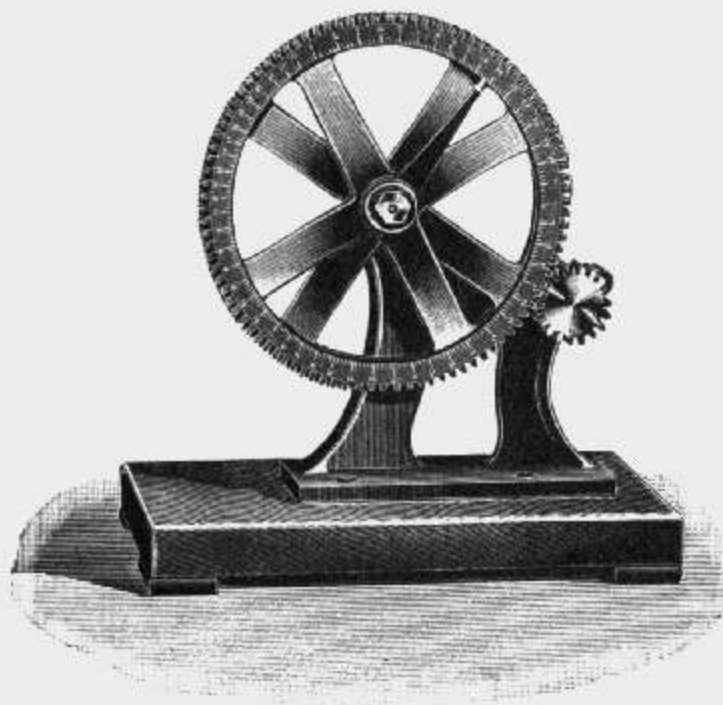
- 8365. Endless screw and toothed wheel of brass, 10 centim. in diameter . . . . . 70

Nos	Francs.
8366. Endless screw with triangular thread and toothed wheel. . . . .	95
8367. Endless screw with double thread and toothed wheel . . . . .	105
8370. <b>Hyperboloid Gearing.</b> The axes do not intersect . . . . .	200
8380. <b>Spiral and toothed wheel</b> gearing. The axes are at right angles but do not meet . . . . .	110

**§ 84. Mechanisms composed of Higher Couples.  
(Trains of Gearing, &c.)**

**Spur-Gearing,** to connect two parallel axes :

8400. Three toothed wheels, one intermedial wheel . . . . .	75
8402. Four toothed wheels, two intermedial wheels . . . . .	90
8404. Five toothed wheels, called <i>hanging wheels</i> , to connect two parallel axes, one of which is variable . . . . .	150
8406. Crank and toothed wheel producing angular velocities alternatly great and small . . . . .	100

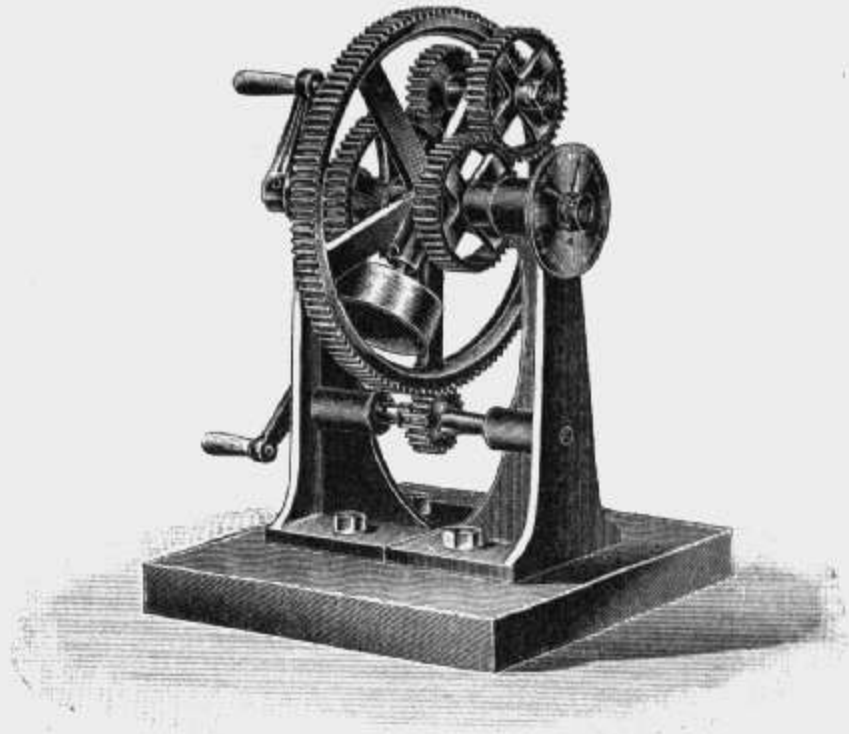


8410.

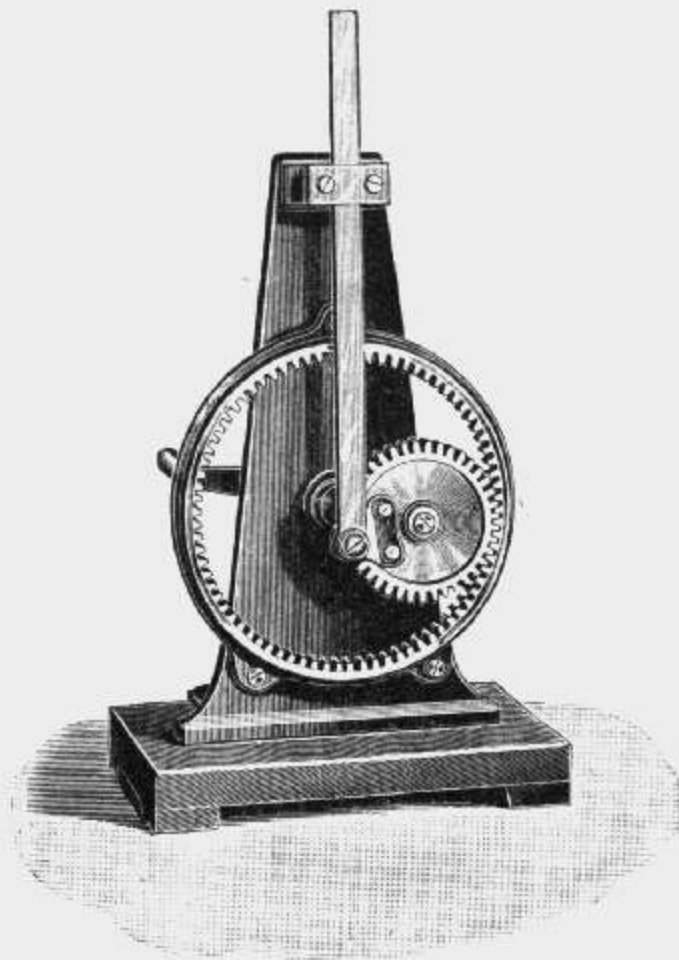
**Spur-Gearing Trains,** to connect any number of parallel axes :

8410. Revolution register with differential toothed wheels ( <i>fig.</i> ). . . . .	120
---	-----

Nos	Francs.
8415. Train of differential gearing . . . . .	150



8420.



8430.

Nos

Francs.

**Spur-Gearing Epicycloidal Trains,** to connect stationary parallel axes and movable ones, the latter revolving around the former :

8420. Differential epicycloidal train (*fig.*) . . . . . 180

**Spur-Gearing Mechanisms,** to transform a continuous circular motion into an alternative rectilinear motion :

8430 **Lahire's** gearing (*fig.*) . . . . . 120

8432. **Watt's** epicycloidal wheel . . . . . 120

8434. Plate guided by a groove and bearing a rack forming an endless chain ; the rack is driven by a movable pinion, acting alternately on each side of the rack . . . . . 150

8436. Partially toothed wheel and double rack . . . . . 130

8438. Connecting-rod, cross-head guides and two racks doubling the path of the alternative motion . . . . . 130

8440. *Interference* mechanism, two toothed wheels, one with 66, the other with 67 teeth, mounted on parallel axes with cranks and connecting-rods coupled with a same beam mounted on the alternative motion rod . . . . . 150

**Spur-Gearing Mechanisms,** to transform a continuous circular motion into an alternative one :

8450. Curved racks and partly toothed pinion . . . . . 130

8452. Interrupted doubly toothed wheel . . . . . 160

8454. Lantern gearing with interrupted wheel and movable pinion . . . . . 140

**Bevel-Gearing Trains,** to connect any number of fixed axles :

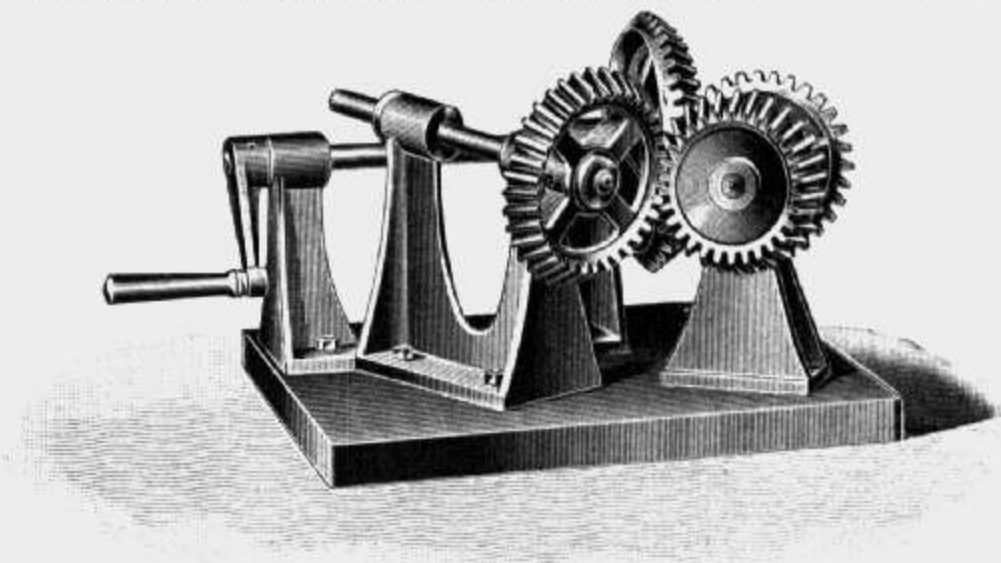
8460. Train of four wheels, to connect two axles by an intermedial axle (*fig.*) . . . . . 110

8465. Differential gearing train . . . . . 220

**Bevel-Gearing Epicycloidal Trains,** to connect stationary axles and movable axles, the latter describing cones around the former.



Nos	Francs.
8470. Differential epicycloidal train . . . . .	200
8471. Epicycloidal train to produce simultaneously the rotation of a sphere around two different axes . . . . .	160



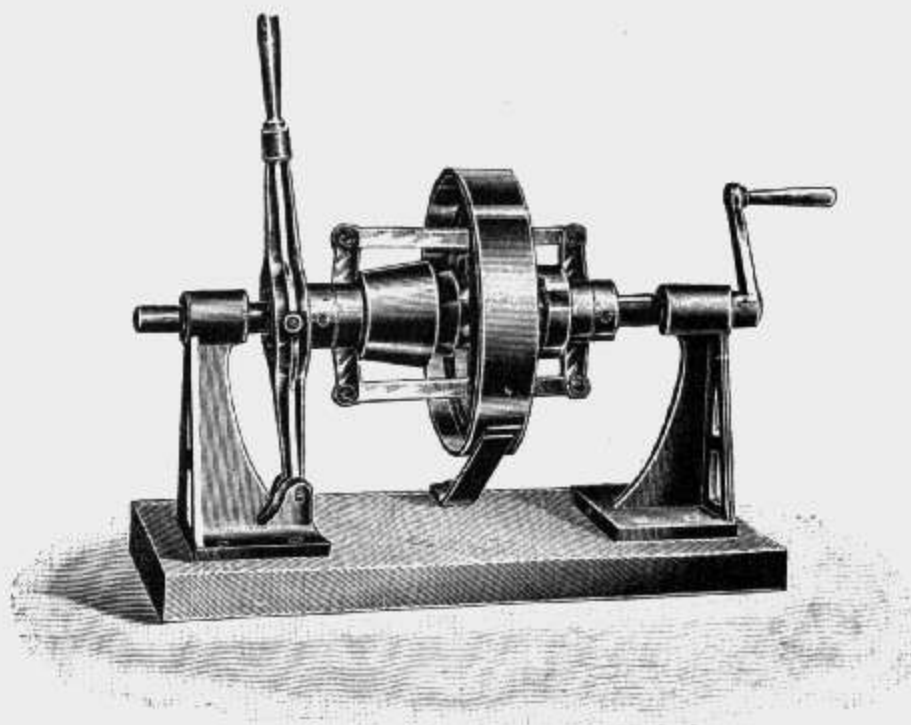
8460.

**Bevel-gearing Mechanisms,** for transforming a continuous circular motion into an alternative motion :

8480. Wheels partly toothed . . . . .	150
---------------------------------------	-----

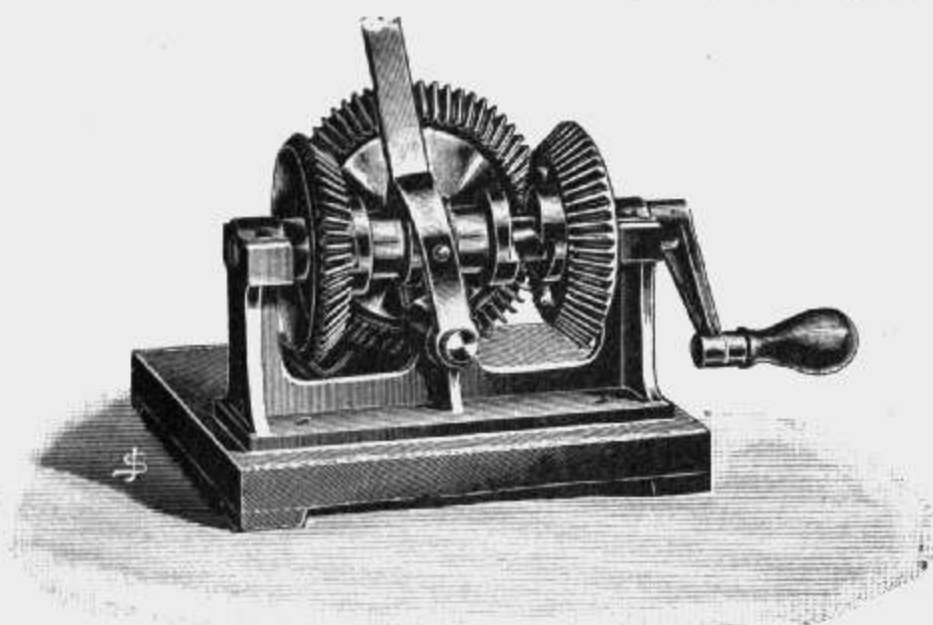
### § 85. Ratchets, Catches, Couplings and Brakes.

8500. Catch pin acting by fraction of a tooth . . . . .	90
8505. <b>Do.</b> with continued action . . . . .	90



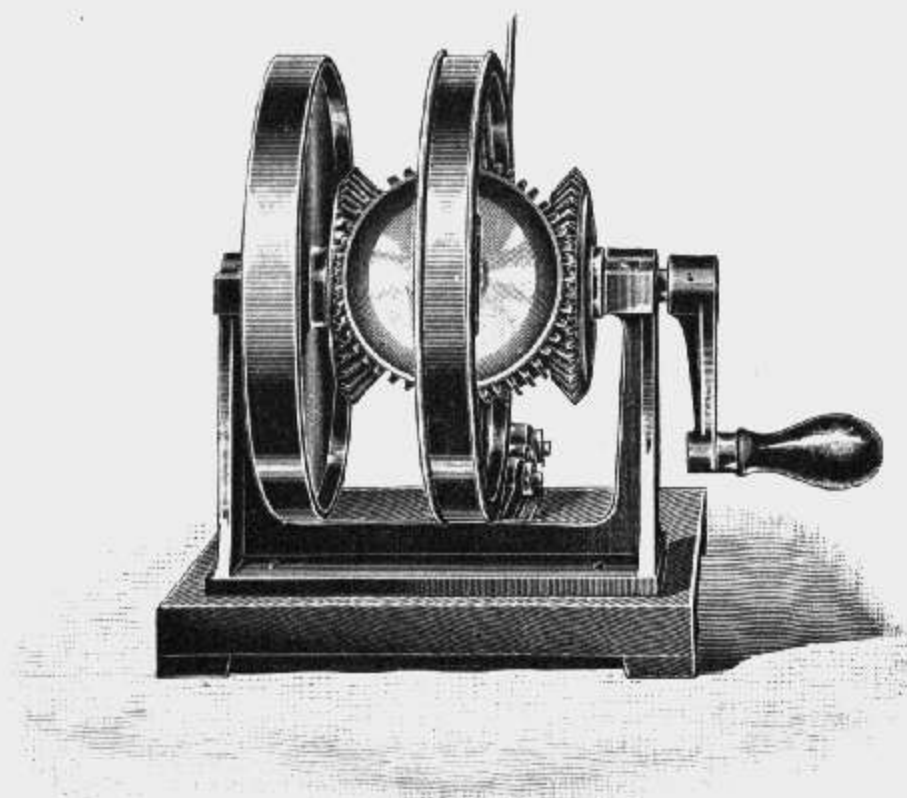
8526.

Nos		Francs.
8510.	<b>Ratchet wheel</b> with continued action . . . . .	90
8520.	<b>Coupling</b> of two parallel shafts by means of an intermedial wheel . . . . .	110
8522.	<b>Do.</b> by a friction cone . . . . .	120
8524.	<b>Do.</b> by a coupling box . . . . .	120
8526.	<b>Do.</b> by a friction cone and coupling boxes ( <i>fig.</i> ) . . . . .	150
8528.	<b>Do.</b> with brake and sun and planet wheel . . . . .	190



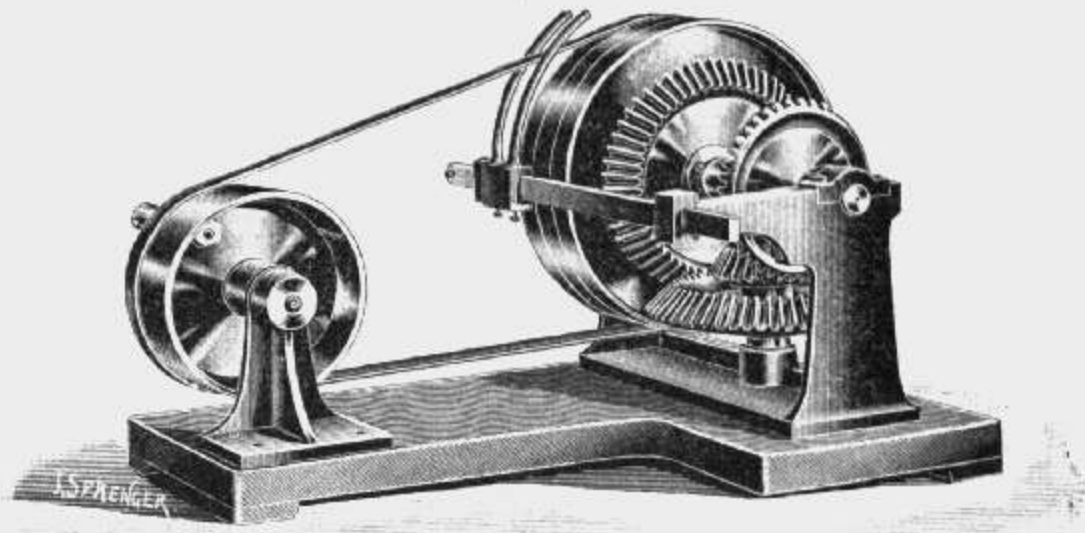
8540.

8530.	<b>Do.</b> with three pulleys, one with teeth on the inside . . . . .	150
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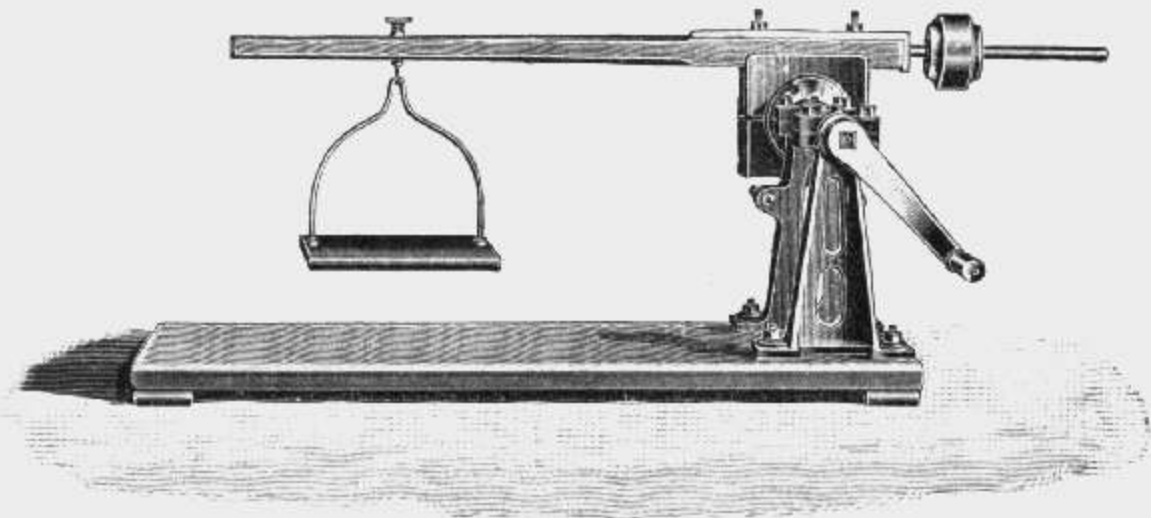
8544.

Nos		Francs.
8540.	<b>Uncoupling</b> with coupling box and conical wheels for reversing the motion ( <i>fig.</i> ) . . . . .	160
8542.	<b>Do.</b> of a toothed wheel by means of a screw . . . . .	100
8544.	<b>Do.</b> with brake and differential wheels ( <i>fig.</i> ) . . . . .	200
8546.	<b>Do.</b> for reversing the motion . . . . .	160
8548.	<b>Do.</b> for reversing the motion and changing the speed ( <i>fig.</i> ) . . . . .	170



8548.

8560.	<b>Prony's Brake</b> ( <i>fig.</i> ) . . . . .	160
-------	--	-----



8560.

8562.	<b>Do.</b> with belt . . . . .	120
8570.	<b>Wedge Pulleys</b> catching by friction . . . . .	60

Nos

Francs.

**§ 86. Mechanisms composed of ductile Elements.**

8600.	<b>Belt Gearing,</b>	between parallel axles, with loose pulley . . . . .	100
8605.	<b>Do.</b>	with differential pulleys . . . . .	100
8610.	<b>Do.</b>	with guiding friction-rollers and pulleys mounted on two axles inclined to any angle . . . . .	100
8615.	<b>Do.</b>	with pulleys, one having Hook's joint . . . . .	120
8620.	<b>Do.</b>	with two pulleys and guides at variable angles.	
8630.	<b>Tackle-block</b>	with differential pulleys . . . . .	60
8650.	<b>Chain Gearing</b>	between two parallel axles . . . . .	120
8660.	<b>Cylindrical Spring Gearing</b>	between any two axles . . . . .	70
	<b>Spring Balances, Dynamometers, &amp;c.</b> See <i>General measuring Instruments</i> , § 05.		

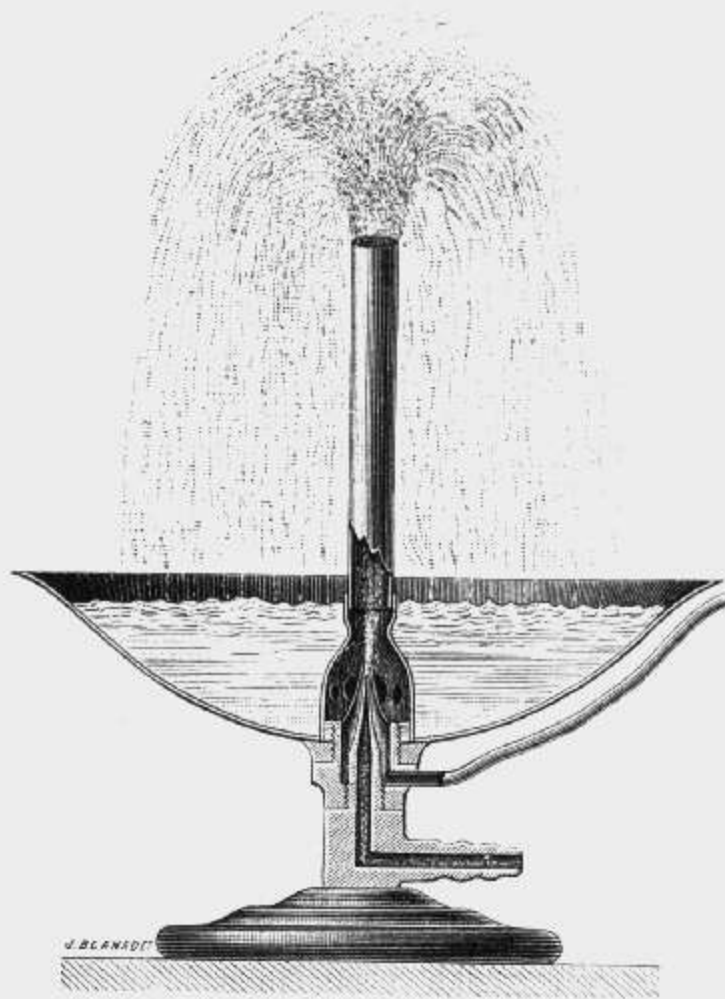
**§ 87. Machines with ductile Parts.**

8700.	<b>Wheel and Axle</b>	with arms at right angles, (wood) . . . . .	18
8705.	<b>Do.</b>	with crank (wood) . . . . .	15
8710.	<b>Do.</b>	differential or « chinese crane », (wood) . . . . .	20
8715.	<b>Do.</b>	with vertical axle, or horse mill (wood) . . . . .	15
8720.	<b>Do.</b>	with single pinion . . . . .	100
8725.	<b>Do.</b>	with double pinion . . . . .	120
8730.	<b>Peg Wheel,</b>	(wood) . . . . .	30
8732.	<b>Capston</b>	(wood) . . . . .	15
8735.	<b>Derrick,</b>	on three legs, (wood) . . . . .	20
8740.	<b>Do.</b>	on four legs (wood) . . . . .	30
8745.	<b>Do.</b>	on two legs or erect post machine . . . . .	250
8750.	<b>Crane</b>	with fixed span . . . . .	100
8755.	<b>Do.</b>	without straining-piece . . . . .	100
8760.	<b>Do.</b>	with variable span . . . . .	150

Nos		Francs.
8765.	<b>Crane</b> for wharfs, with stationary axle of rotation . . . . .	250
8770.	<b>Do.</b> with axle of rotation under ground . . . . .	250
8775.	<b>Do.</b> for wharfs, of sheet iron . . . . .	350

### § 88. Hydraulic Machines and Mechanisms.

8800.	<b>Wheel</b> with movable paddles for steam-boats . . . . .	250
8801.	<b>Do.</b> overshot, made of wood . . . . .	300
8802.	<b>Do.</b> overshot, made of iron . . . . .	300
8803.	<b>Do.</b> with paddles and sliding flood-gates . . . . .	300 to 550
8804.	<b>Do.</b> with overflow flood-gate . . . . .	300 to 550
8805.	<b>Do.</b> Poncelet's . . . . .	350
8806.	<b>Do.</b> tangential . . . . .	600
8807.	<b>Do.</b> to raise water . . . . .	350
8820.	<b>Tympanum</b> . . . . .	250



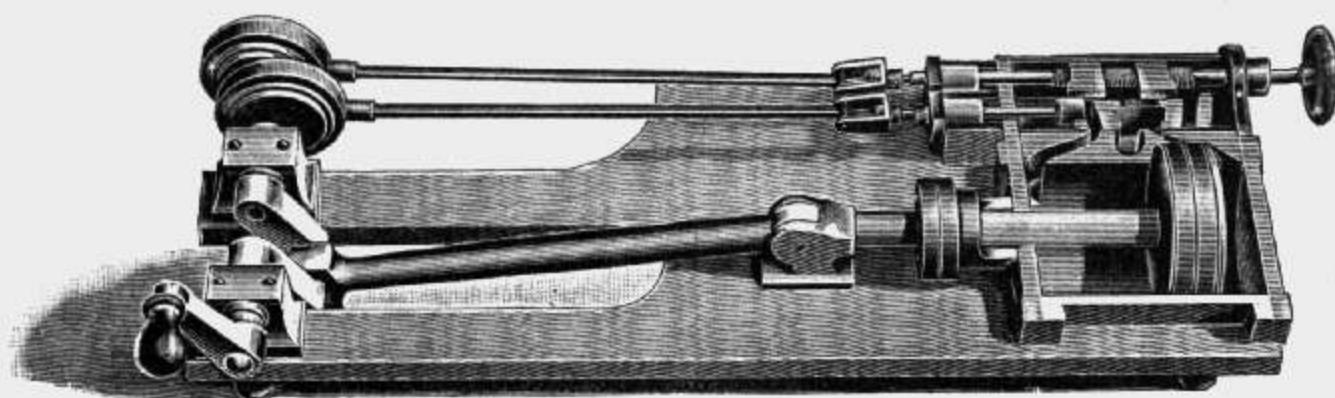
8860.

Nos		Francs.
8825.	<b>Jonval's Turbine</b> , two superposed wheels . . . . .	500
8830.	<b>Fourneyron's Turbine</b> , two wheels one inside the other . . . . .	500
8835.	<b>Reichenbach's hydraulic Machine</b> with a column of water . . . . .	1200
<b>Hydromotors, rotary Pumps, see § 96.</b>		
8840.	<b>Regulator</b> of hydraulic motor . . . . .	500
8850.	<b>Apparatus</b> with rack and pinion, to raise the flood-gates . . . . .	80
8855.	<b>Do.</b> with screw and conical wheels to raise the flood-gates. . . . .	100
8860.	<b>Turrettini's hydraulic Aspirator</b> ( <i>fig.</i> ) . . . . .	120

**§ 89. Steam-Engines.**

**Models of Steam-Engines**, section of cylinder and slide-valve; working by means of a crank and mounted on a stand :

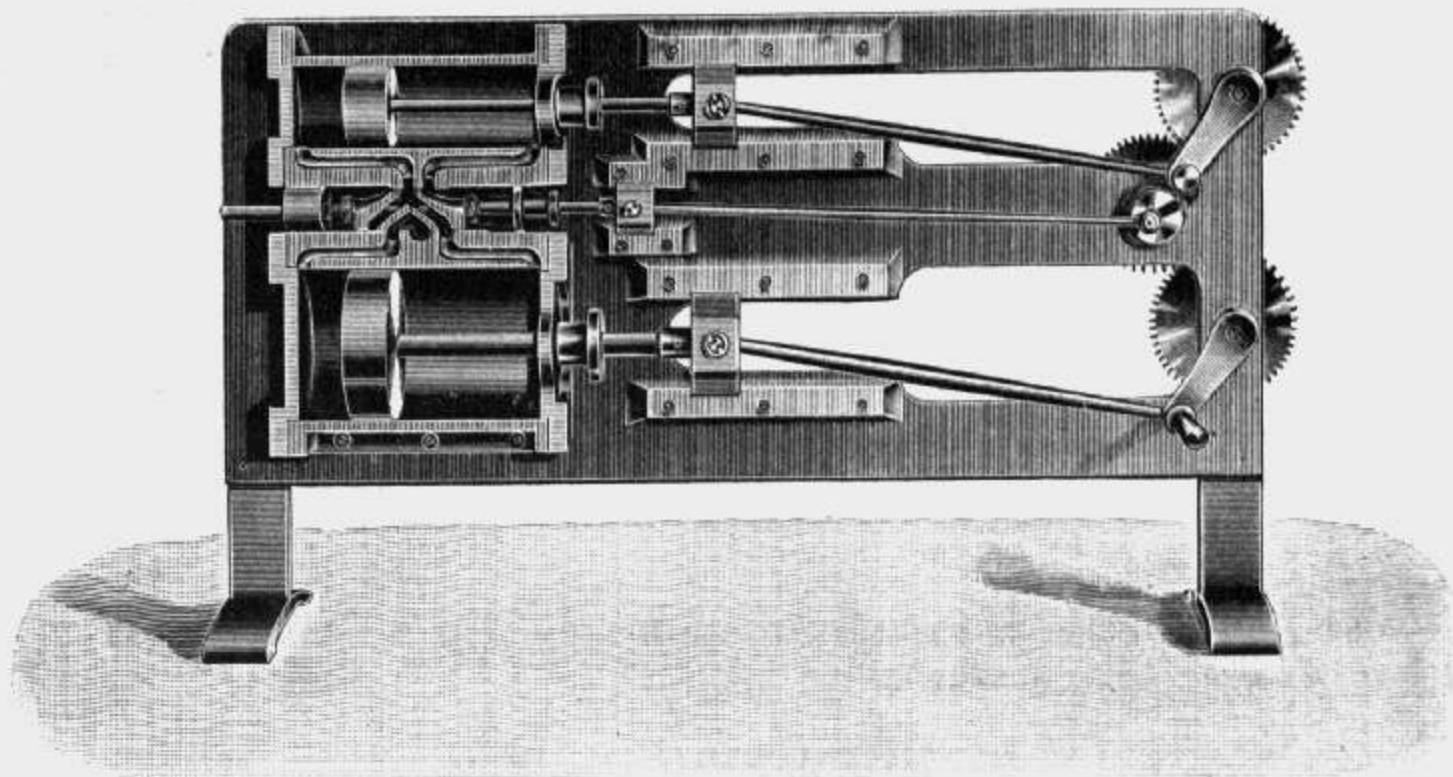
	Wooden model.	Iron model.
8900. Model, single expansion . . . . .	90	
8902. Do. double expansion ( <i>fig.</i> ) . . . . .	110	
8904. Do. Farcot's expansion . . . . .	125	210
8906. Do. Meyer's expansion . . . . .	130	225
8908. Do. of Woolf's machine ( <i>fig.</i> ) . . . . .	140	240



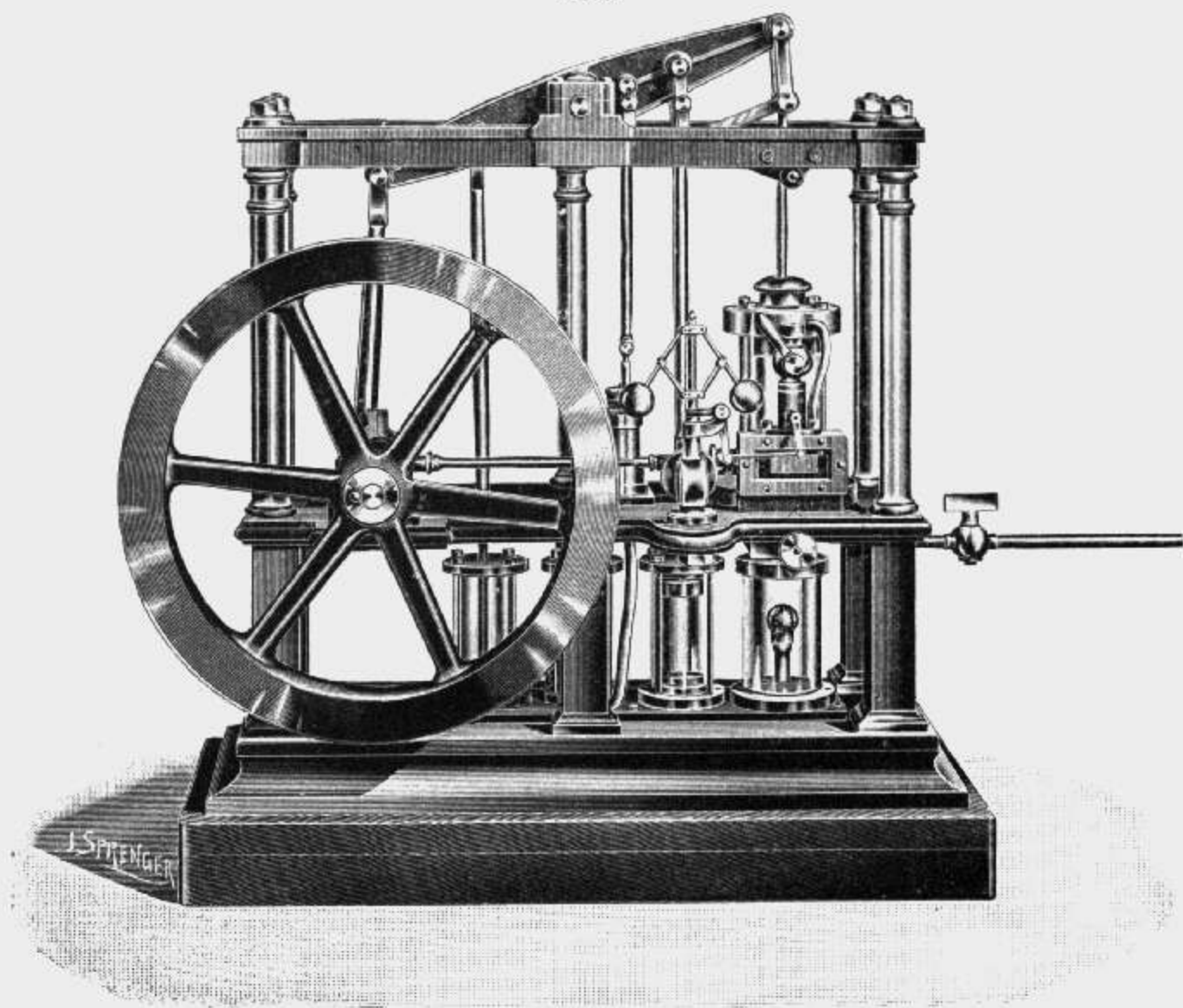
8902.

**Models of Steam-Engines working.**

8910.	High pressure engine, horizontal cylinder . . . . .	500
8911.	Do. vertical cylinder . . . . .	500
8912.	Do. oscillating cylinder . . . . .	500

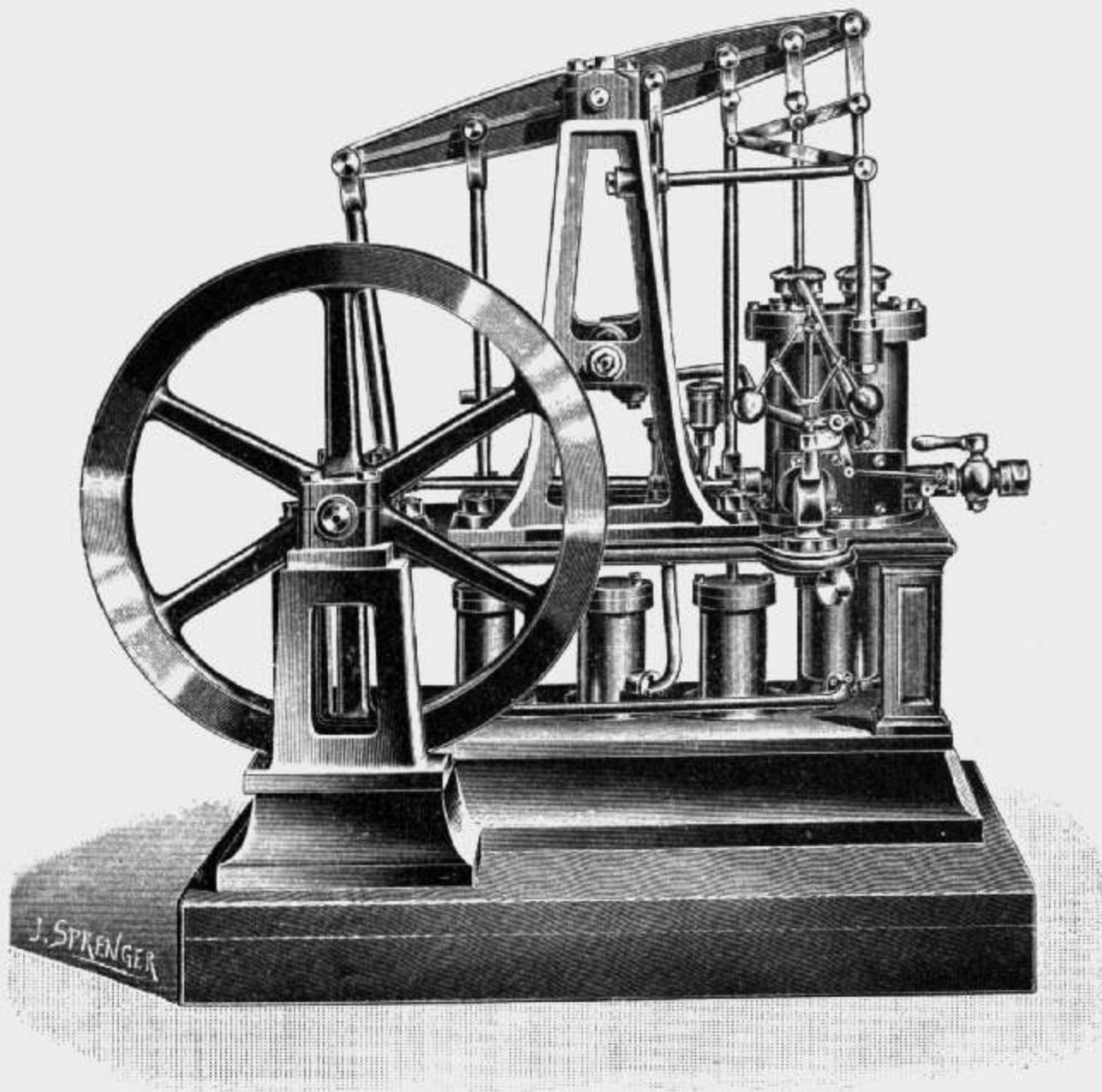


8908.



8920.

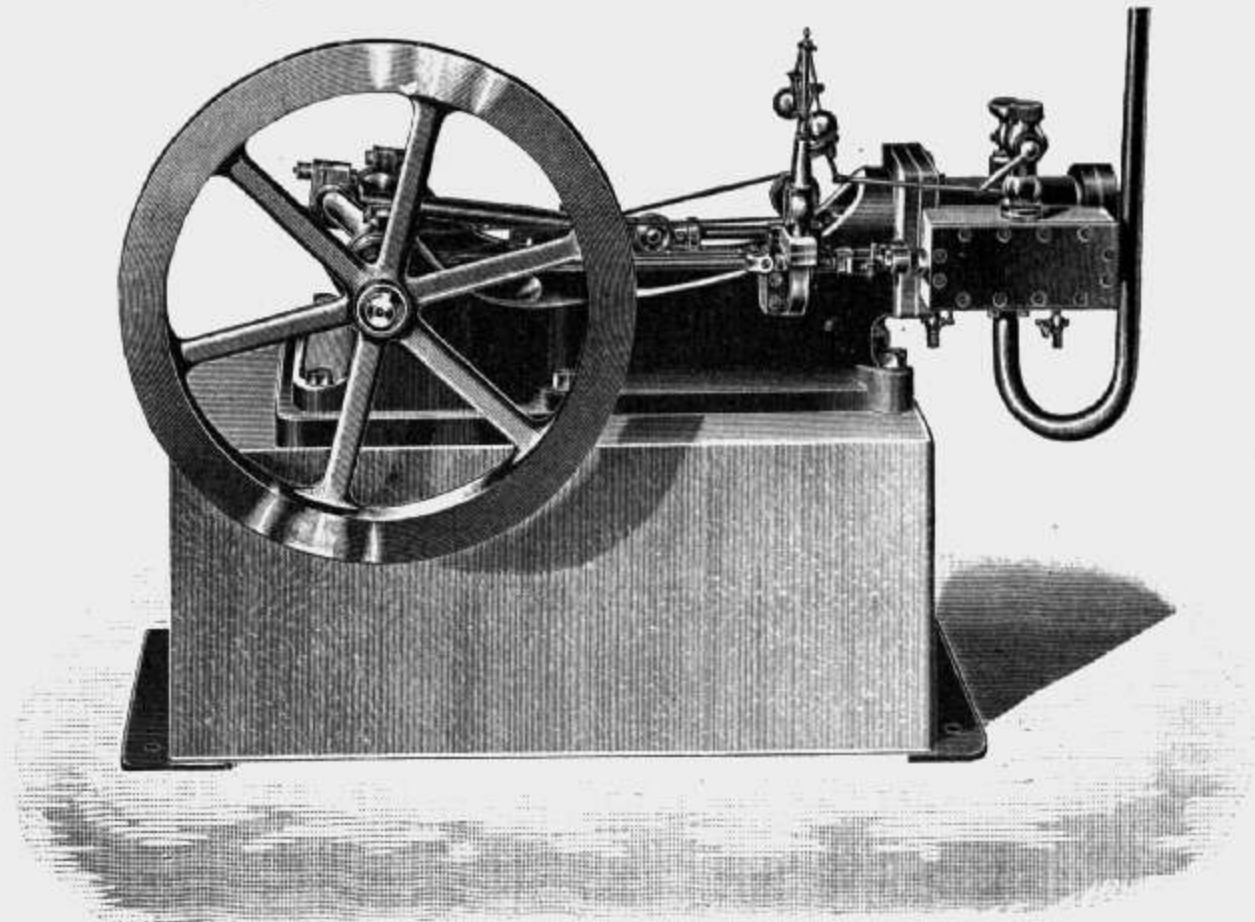
Nos	Francs.
8915. <b>Boiler</b> of copper for the above engines . . . . .	150
8916. <b>Vertical Boiler</b> of copper, with interior tube, heated by gas. Model with sheet iron covering and pipe for the evacuation of gases, manometer, two water levels, a feeding valve and a safety valve; standing a pressure of eight kilogr. per square centimetre; with gas burner . . . . .	300
8920. <b>Watt's Steam-Engine</b> , working at low pressure and with condensation. Model on cast iron stand with six pillars. The body of the pump and the condenser in crystal-glass for demonstration. With its boiler ( <i>fig.</i> ) . . . . .	1200
8925. <b>Woolf's Machine</b> with two bronze cylinders and condenser. With boiler ( <i>fig.</i> ) . . . . .	1300



8925.



Nos	Francs.
8930. <b>Horizontal Steam-Engine</b> , high pressure and variable expansion ; Watt's regulator ; feeding pump ; nominally $\frac{1}{6}$ horse-power, with boiler n° 8916 ( <i>fig.</i> ) . . . . .	1300



8930.

8940. <b>Beam</b> for steam-engine with counter-guide . . . . .	90
8945. <b>Do.</b> without axis of rotation . . . . .	100
8950. <b>Connecting rod</b> and oscillating cylinder . . . . .	100
8955. <b>Watt's Regulator</b> . . . . .	180
8956. <b>Do.</b> parabolic . . . . .	220
8957. <b>Do.</b> with a Saturn's ring . . . . .	190
8960. <b>Giffard's Injector</b> , bronze section model . . . . .	65

## CHAPTER 9

INDUSTRIAL MECHANICS, ACCESSORIES  
FOR LABORATORY &C.

- §§ 90 and 91. Accessories for Laboratory.  
 92. Instruments and Accessories used in manufactures.  
 93. Gas Furnaces.  
 95. Refrigerating and Ice Machines.  
 96. Hydromotors and Rotary Pumps.  
 97 and 98. Applied Electricity (dynamos, electric meters,  
 electro-magnets).

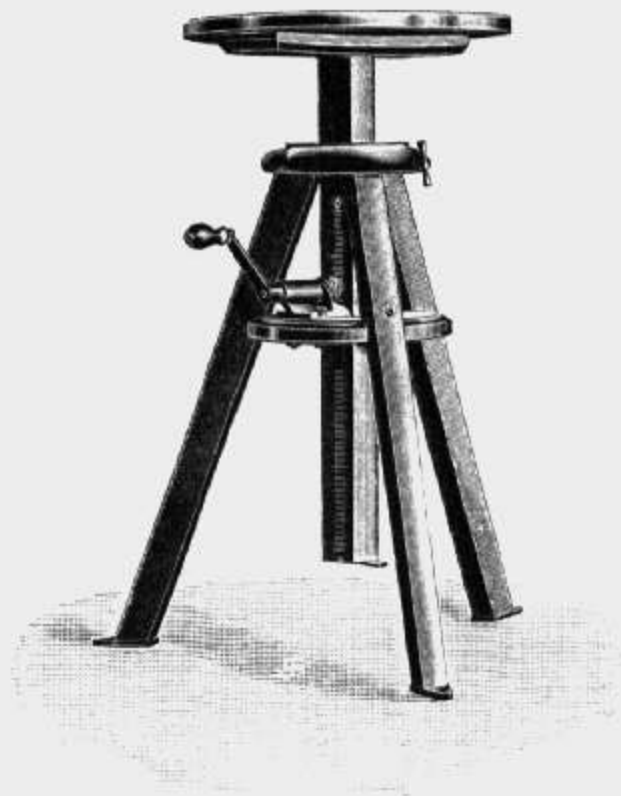
Nos

Francs.

## §§ 90 and 91. Accessories for Laboratory.

9000. **Platform of hard wood**, three levelling screws, 30 centimetres in diameter . . . . . 20.—  
 9005. **Platform of cast iron**, three levelling screws, 30 centim. in diameter . . . . . 25.—  
 9010. **Movable Shelf** with rack and pinion 15 to 20 centim. high, varying within the limits of 10 centim. in height . . . . . 50.—  
 9015. **Movable Shelf** in walnut wood, height regulated by a rack and pinion and made fast by an annular clamp, plate 25 centim. in diameter . . . . . 25.—

Nos	Francs.
9020. <b>Table</b> 50 centim. in diameter, or square, according to order. Very strong make for the installation of instruments. The top is supported by a central pillar that fits into a tripod with tightening ring, standing on the ground . . . . .	70.—
9025. <b>Laboratory Table</b> same dimension as the preceding, worked by a rack and pinion and a tangent screw, offers all desirable stability. Commendable model ( <i>fig.</i> ) . . . . .	90.—



9025.

**Levels,** see *Geodesy*, § 12.

9030. **Screw-nuts for connecting pipes,** plug-nuts, inter-medial pieces, etc.

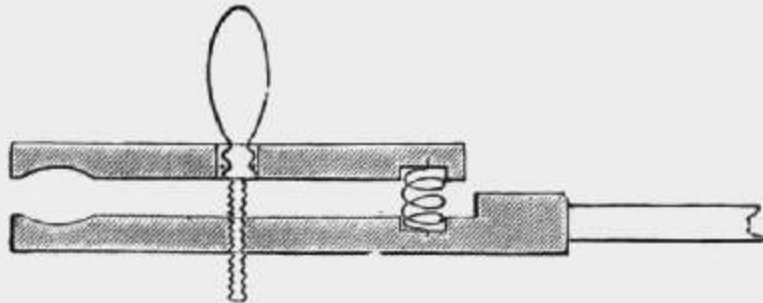
**Brass Stop-cocks.**

9040. Straight stop-cock with two screw threads . . . . .	6.—
9041. Straight two-way cock . . . . .	9.—
9042. Straight three-way cock. . . . .	10.—
9043. Gay-Lussac's double stop-cock for admitting vapours into a vacuum . . . . .	12.—
9044. Small double-necked cock, adapting itself to rubber tubes . . . . .	3.50

Nos	Francs.
9050. <b>Spring Pliers</b> , of brass, for Mohr's test tube and rubber tubes ( <i>fig.</i> ): each . . . . .	0.60
per dozen . . . . .	5.—
9052. <b>Adjustable wooden Pliers</b> of Prof. C. Barus, for holding fragile glass tubes ( <i>fig.</i> ) . . . . .	5.—

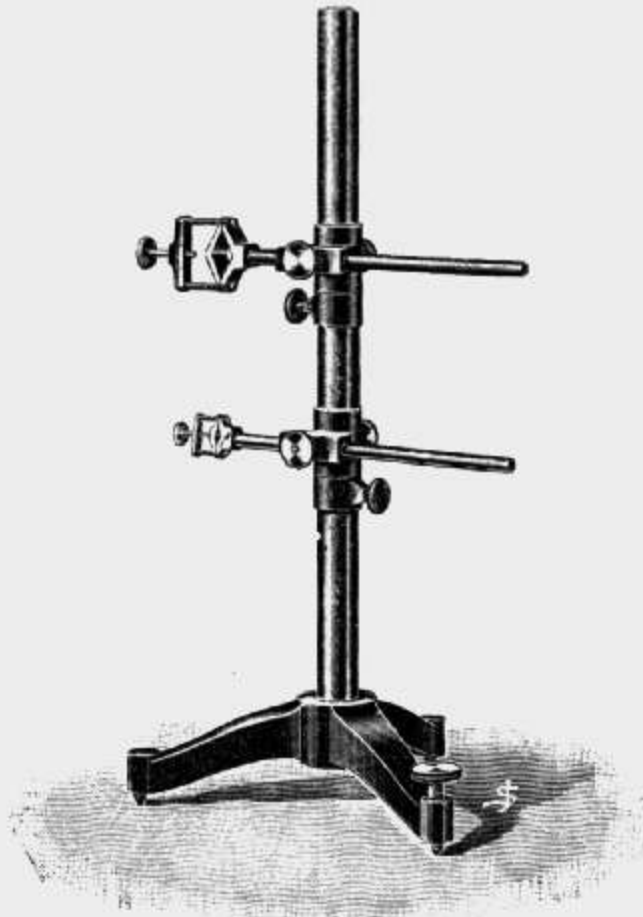


9050.



9052.

9055. <b>Stand for holding Objects</b> , with adjustable arms, for physical laboratories ( <i>fig.</i> ) . . . . .	90
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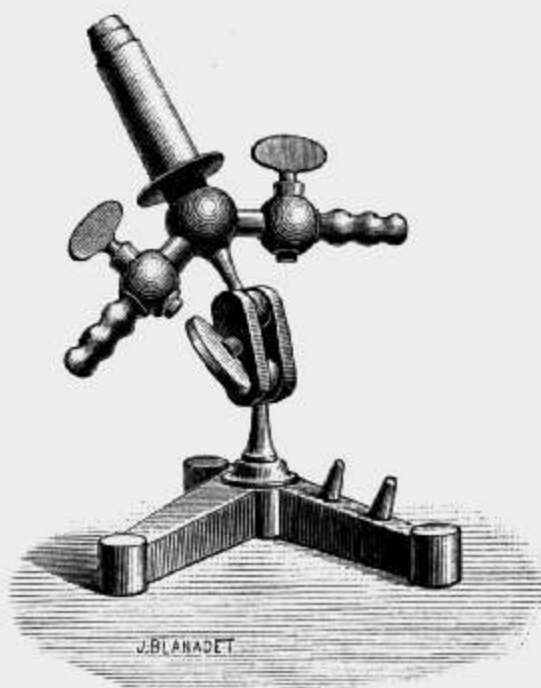


9055.

**Crucible pliers**, n<sup>o</sup> 9395.

9060. <b>Bunsen's Burner</b> with air regulator . . . . .	4.25
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Nos		Francs.
9061.	<b>Bunsen's Burner</b> to fit stand n° 9126 . . . . .	5.50
9065.	<b>Do.</b> with cock to admit the gas . . . . .	6.—
9066.	<b>Do.</b> with cock regulating at the same time the admission of air and gas. . . . .	6.25
9067.	Chimney-holder and additional chimney . . . . .	1.—
9070.	<b>Gas blow-pipe</b> , working with a blower ( <i>fig.</i> ). . . . .	21.—



9070.

**Blower-burner** n° 9392.

9075. **Cast-iron Grate**, to boil mercury in barometer tubes . . . 12.—

**Funnel** for filling crucibles, n° 9396.

**Gas Stoves**, see § 93.

9080. **Marie-Bath**, with constant level, 16 centim. in diameter,  
and several rings. Of copper with three brass legs . . . . 15.50

9081. **Do.** 22 centim. in diameter. Iron legs . . . . 26.—

**Filter Stand, small model** of brass, filter-holder with  
three points of support fitted with cork.

Nos	Francs.
9100. Stand 40 centim. high . . . . .	Fr. 2.30
9101. Ring 30 millim. in diameter . . . . .	" 2.—
9102. Do. 55 " . . . . .	" 2.20
9103. Do. 80 " . . . . .	<u>" 2.50</u>
	9.—

**Filter Stand, large Model,** of iron; frame covered with brass.

9105. Stand 65 centim. high . . . . .	Fr. 2.80
9106. Ring 70 millim. in diameter . . . . .	" 3.—
9107. Do. 100 " . . . . .	" 3.45
9108. Do. 130 " . . . . .	<u>" 3.75</u>
	13.—

**Chemical Stand, small Model,** of brass.

9110. Stand, 40 centim. high . . . . .	Fr. 2.30
9111. Ring 30 millim. in diameter . . . . .	" 1.90
9112. Do. 55 " . . . . .	" 2.—
9113. Do. 80 " . . . . .	" 2.20
9114. Test tube pliers . . . . .	<u>" 5.35</u>
	13.75

**Chemical Stand, intermediate Size,** of iron; frame covered with brass (*fig.*).

9120. Stand 65 centim. high . . . . .	Fr. 2.80
9121. Ring 70 millim. in diameter . . . . .	" 2.—
9122. " 100 " " " . . . . .	" 2.20
9123. " 130 " " " . . . . .	" 2.30
9124. Test tube pliers with double press action . . . . .	" 5.45
9125. " larger dimensions . . . . .	" 5.65
9126. Fork for adjusting the Bunsen's burner to the proper height . . . . .	" 1.90
9127. Jointed pliers for retorts . . . . .	<u>" 7.20</u>

29.50

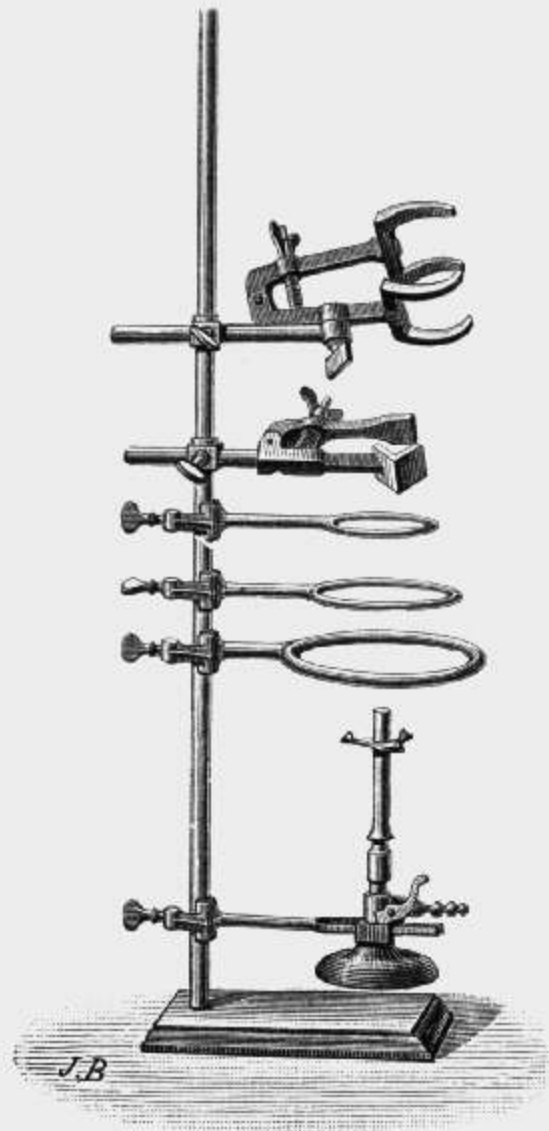
Nos	Francs.
9130. <b>Chemical Stand, large model,</b> heavy cast iron plate with frame, one metre high, and covered with brass . . . . .	5
Same rings and pliers as for preceding model.	

**§ 92. Instruments and Accessories used in Manufactures.**

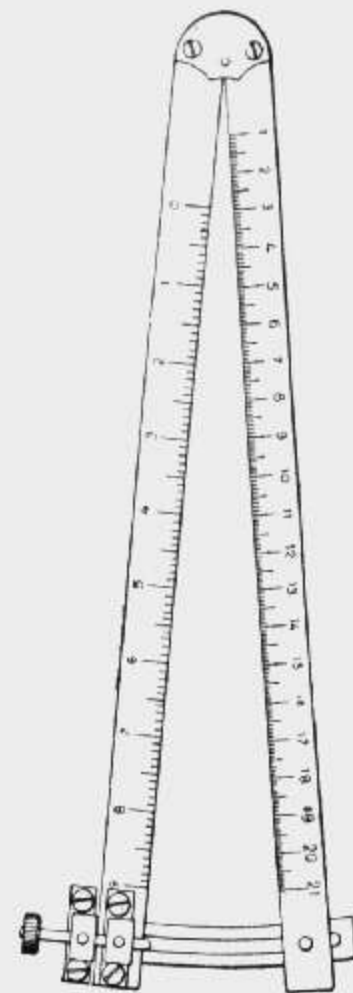
**Steel Metre Scale for Modeller,** see n° 0180.

**Double Compasses,** called twelfths' tool employed in watchmaking, see n° 0355.

9200. <b>Proportional Compass</b> for gearing wheels, invented by J. Beau, watchmaker of Lyons. Each tool is accompanied by explanations for its use ( <i>fig.</i> ) . . . . .	50
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9120.



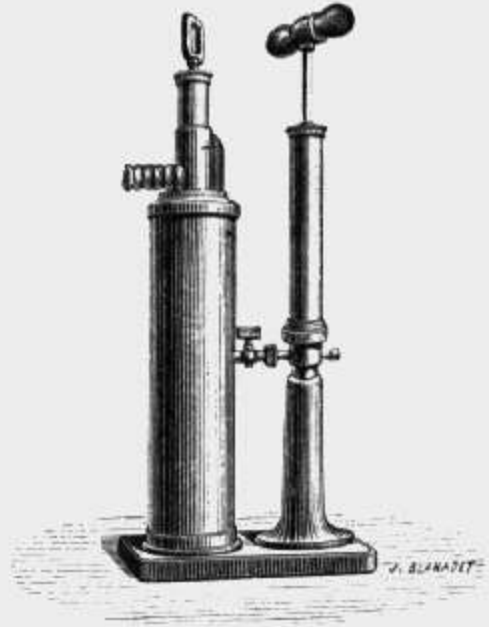
9200.

Nos		Francs.
9205.	<b>Steel-Calliper</b> , for case-mounters, divided up to 36 lines reading to $\frac{1}{12}$ line . . . . .	15
	<b>Callipers</b> for measuring watch-glasses :	
	A. Wedge-shape of sheet brass 6 millim. thick, with strong steel bands, divided on both sides into eighths of lines, usual numbering and into lines.	
9210.	From 3 to 15 lines . . . . .	24
9211.	From 3 to 18 " . . . . .	30
9212.	From 14 to 24 " . . . . .	25
9213.	From 14 to 26 " . . . . .	30
9214.	From 15 to 23 " . . . . .	20
9215.	From 18 to 30 " . . . . .	30
9216.	From 3 to 30 " . . . . .	50
9220.	B. Straight shape, small model, divided on both sides into half or quarter lines, as far as n <sup>o</sup> 35, with steel bands, each	5
	per dozen . . . . .	55
9221.	Do. without steel bands, each . . . . .	4
	per dozen . . . . .	42
	<b>Scales, Workshop Callipers, Compasses</b> of different kinds, see <i>General Measuring Instruments</i> , Chap. 0.	
9230.	<b>Heating Box</b> , cabinet size for regulating watches and clocks	60
9231.	Do. observatory size . . . . .	
9235.	<b>Refrigerating Box</b> , model adopted by the Observatories of Geneva and Neuchâtel . . . . .	280
9250.	<b>Thury's Compression Pump, discharging instantaneously</b> , for cleaning up gas branches and pipes ( <i>fig.</i> ). This pump, superior to those which were previously proposed for cleaning gas pipes etc., may be advantageously employed at all times, but especially in winter, to rapidly clear branch-pipes and other apparatus from all deposits of water rime or naphthaline. This pump works normally under a	



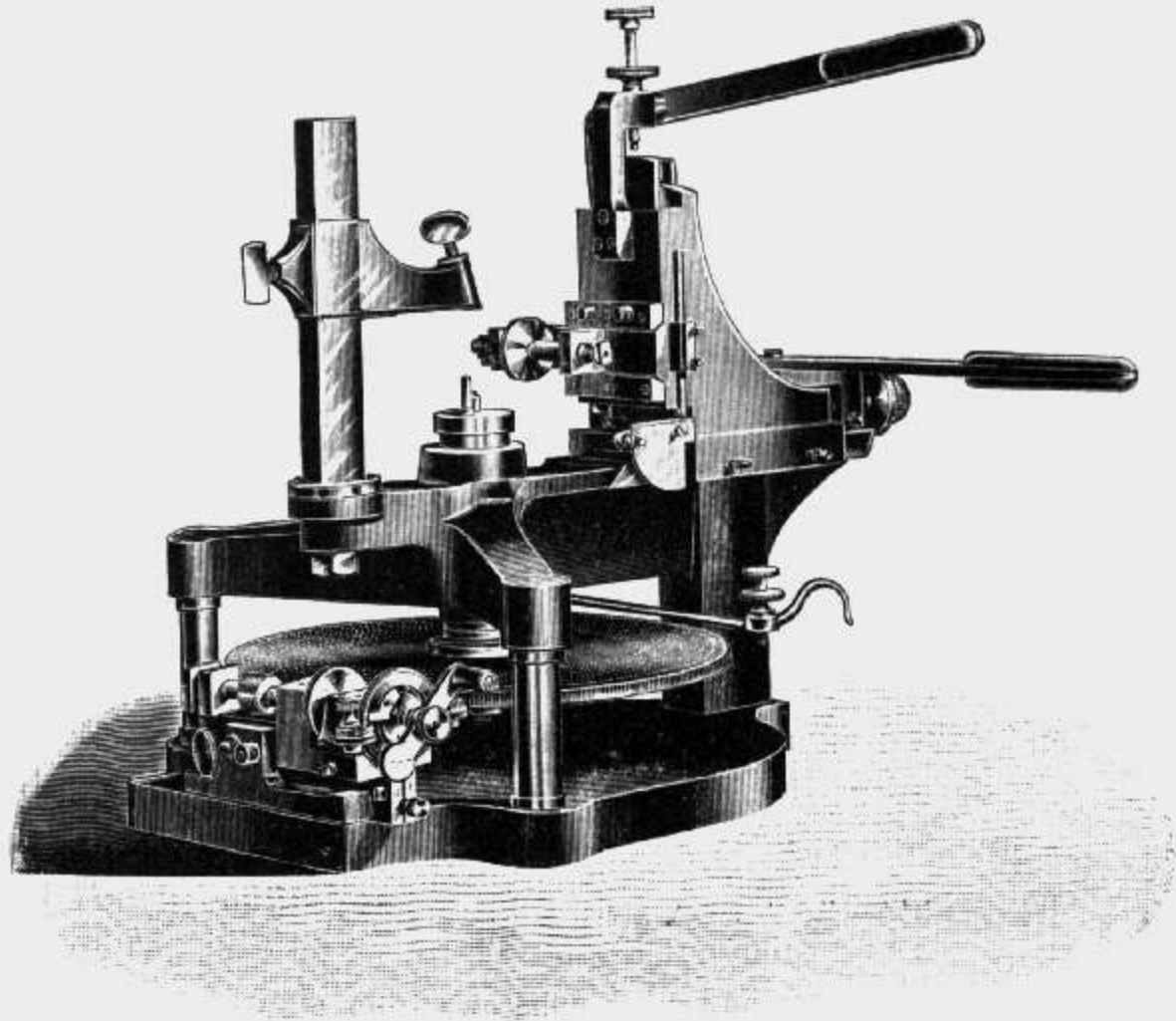
Nos

Francs.



9250.

pressure of four atmospheres and is employed by more than  
 six hundred Gas companies. *Special prospectus* . . . . . 165



9260.

Nos	Francs.
9260. <b>Ratchet-Engine</b> , to cut pinions and gear-wheels to 100 millim. in diameter ( <i>fig.</i> ) . . . . .	900
<b>Thury and Amey's Obturator</b> , see n° 2965 and following.	

### § 93. Gas Furnaces, Perrot's System, patented.

*Designed for melting and tempering metals, enamelling, burning in colours on porcelain, assaying gold and silver, annealing gold &c.*

Bronze Medal. Paris Universal Exhibition 1867.

Grand Gold Medal, awarded by the Geneva Society of Arts.

These furnaces, which the Société Genevoise is alone authorized to make by D<sup>r</sup> Perrot, are distinguished for the following advantages.

*Easy installation*, a gas pipe and a sheet iron pipe 4 metres long are sufficient for the admission of fuel and the removal of the products of combustion; the absence of ashes and coal allows great cleanliness.

*Saving on fuel*, even if the gas were to cost 40 centimes per cubic metre. Saving on crucibles and muffles, which being no longer in contact with the ashes, wear only inside. Saving on the waste of precious metals when melting gold and silver, as there are no ashes. Saving of time, the length of operations being notably reduced.

All the temperatures below 1400° may be obtained without blasting bellows.

**Melting Furnaces.** — These furnaces, in addition to the general advantages pointed out above, are also distinguished for the following qualities :

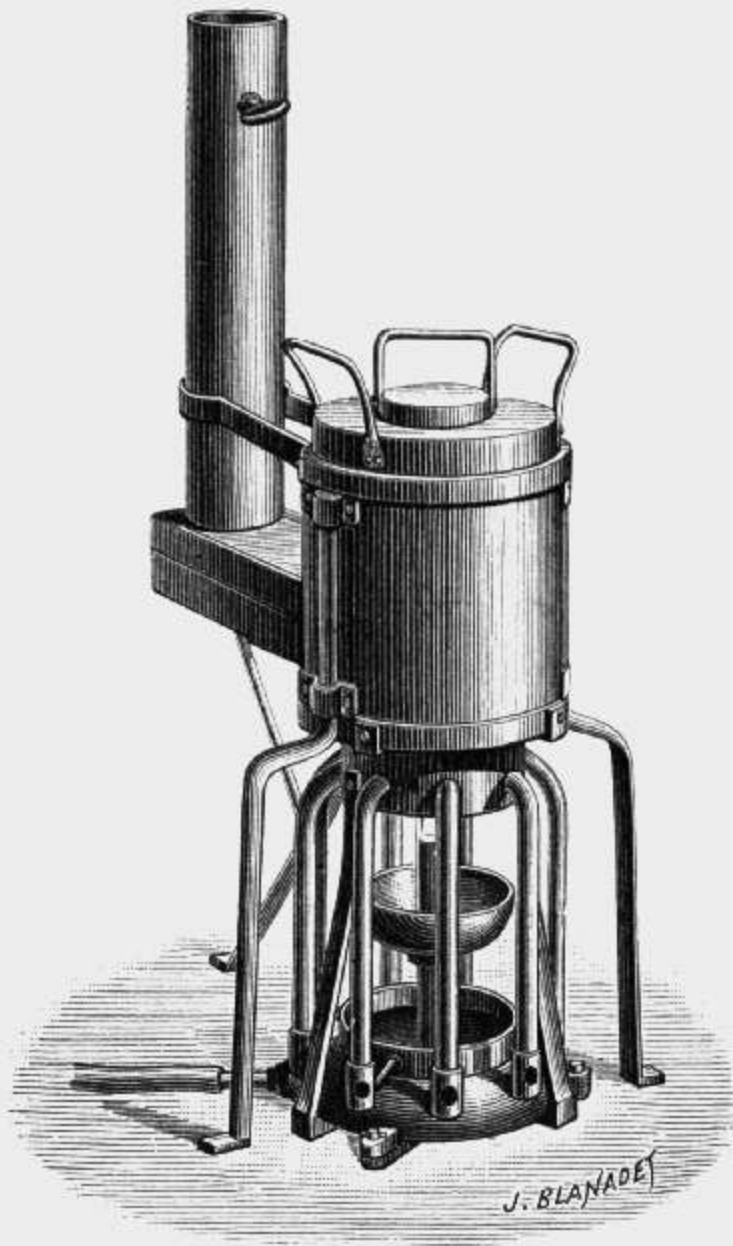
There is no longer a waste of precious metals carried away in the pipes, the draught being very slight, and the gases surrounding the crucible being maintained at will reductent, neutral or oxidizing.

In case of leaking or bursting of the crucibles, the metal is entirely recuperated in a cup placed directly above the burner and the operation may be resumed in a few minutes.

Nos

Frans.

During the whole time, the melting may be controlled without the operation being interrupted. The temperature is very easily regulated and maintained indefinitely. Gas may be employed at a very low or at a very high pressure, the only important factor being the quantity of gas burned per minute.



9300.

Besides the ordinary sizes indicated below the Society sells melting furnaces whose capacity can reach 60 kilogr. of silver. For these large furnaces the average expenditure of gas is 1 cubic metre per kilogr. of fine melted silver. For smaller sizes, the expenditure is slightly greater (*fig.*).

Nos	Height of collar Centim.	Inside diameter of collar Centim.	No. of the corresponding crucible of Paris	Available capacity of crucible Liters.	Weight of fine silver Kilogr.	Weight of gold 18 k. Kilogr.	Francs.
9300.	54	36	Black lead crucible Diam. 21 cm. height 25 cm.	3,700	37	60	350
9301.	50	30	18	2,000	20	33	250
9302.	40	30	16	1,400	14	23	240
9303.	40	26	14	0,800	8	13	240
9304.	33	23	12	0,500	5	8,5	230
9305.	30	20	10	0,250	3	4,2	220
9306.	28	18	9	0,200	2	3,3	220
9307.	23	16	8	0,140	1,5	2,3	210
9308.	23	14	6	0,080	0,8	1,5	200
9309.	17	11	This furnace is especially designed for laboratories . . .				120

The available capacities of the crucibles in the above table are such that the metal in fusion leaves about 20 to 25 millim. in height unfilled.

The quantity of matter necessarily depends on the nature of the metal; the specific weight of fine silver has been taken equal to 10,3; fine gold, 19,3; gold 18 karats, 16,5; gold 14 karats, 15. To obtain the weight expressed in grams, multiply the capacity by the specific weight of the metal to be melted. These weights are only approximative on account of the variations due to the crucibles.

**Enameller's Furnaces with horizontal muffles,** used in enamel baking, dial manufacturing, porcelain painting, etc.

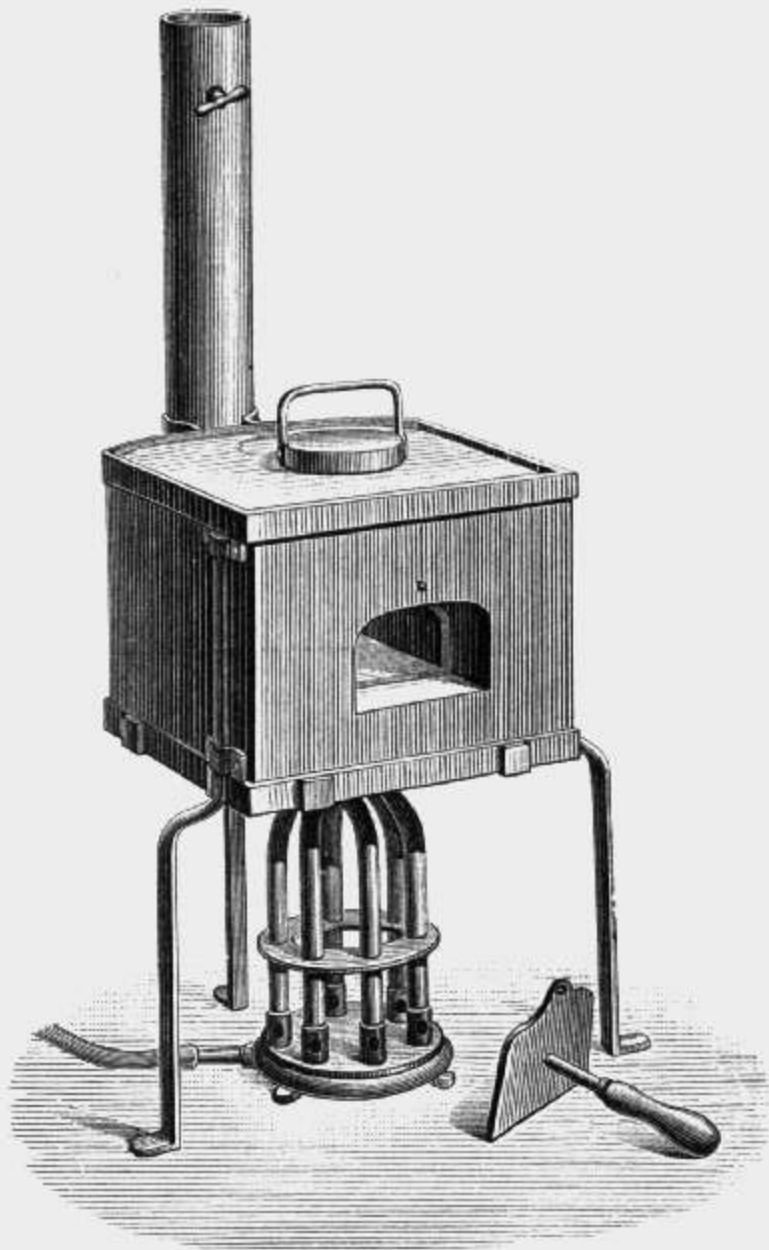
The muffles of these stoves are wider at the bottom (24 cm. for the large size) in order to shift the trays more easily and to diminish as far as possible the radiation of heat through the orifice of the muffle.

	Breadth Centim.	Height Centim.	Depth Centim.	
9315. <i>Large furnace (fig.), muffle</i> . . . . .	20	6	34	250
9316. <i>Medium size do.</i> . . . . .	10	4,5	26	215
9317. <i>Small size do.</i> . . . . .	4,3	2,1	10,2	60

Nos

Francs.

**Tempering or Hardening Furnaces.** Heating by gas presents great advantages, whether for tempering steel or for cementing. The perfect regularity of the temperature secures a uniform and regular hardening. The objects not being sub-



9315.

jected to the direct action of the fire remain unaltered. These furnaces are also used for hard soldering. In the large size furnaces, circular openings may be cut out in the upper part of the muffle, to introduce objects, which could not otherwise enter the furnace.

Nos				Francs.	
	Width Centim.	Height Centim.	Depth Centim.		
9320.	<i>Large furnace, muffle</i>	20	12	50	400
9321.	<i>Do. do.</i>	24	9,5	45	350
9322.	<i>Do. do.</i>	20	6	34	250
9323.	<i>Medium size do.</i>	10	5	26	215
9324.	<i>Small furnace do.</i>	4,8	2	10	60
9325.	<i>Do. do.</i>	4	1,5	10	50

### Tempering and Enamelling Furnaces with

**muffles open on both sides.** — These furnaces have the great advantage of admitting objects on one side and letting them be taken out on the other side. By passing them slowly across the muffle they reach a suitable temperature for the tempering. One of the openings can also be closed by means of a refractory clay brick; by pushing the brick into the centre of the muffle, the latter is divided into two parts and each part can be utilized separately.

	Width Centim.	Height Centim.	Depth Centim.		
9330.	<i>Large furnace</i>	50	12	120	1250
9331.	<i>Medium size</i>	24	12	60	480
9332.	<i>Do.</i>	24	8	60	400
9333.	<i>Do.</i>	24	5	60	350
9334.	<i>Do.</i>	12	10	58	325

9340. **Tempering Furnace for Watch-Springs,** circular shape, of cast iron or clay, 185 millim. in diameter and 90 millim. high.

In this model the top is provided with a hinge, for taking out of the vessel which contains the spring box.

The latter, being protected by a red-hot surrounding, can scarcely cool during its passage from the oven to the tempering bath.

The advantages of this model are: saving of fuel, great uniformity of tempering, temperature easily regulated, and the operator protected against the heat of the stove . . . . .

250

Nos Francs.

9345. **Furnace for restoring Watch-Springs.**

The burner is provided with a regulating cock which commands the admittance of gas . . . . . 35

**Annealing Furnace for Gold.** This stove specially designed for watch case-mounters, completes the melting furnace. It permits entirely doing away with the use of coal in workshops. There can be no danger of melting the metal, as often happens in annealing with coal.

For annealing gold bars, two opposite openings are made in the framing, for allowing bars or wires of any length to be exposed to the fire without having to roll them up. When the wires are thin enough they are made up into bundles and placed in the cupel where the annealing takes place without any watching. For the annealing of hinges a clay tube is fitted in the openings, which thus prevents all risk of these delicate pieces being melted by some sudden heat.

These ovens are advantageously employed to harden certain pieces, such as rolling machine rollers, stamps, wedges, &c. which have to be tempered in lots, as the temperature is maintained and regulated at will.

	Diam. Centim.	Depth Centim.	
9350. <i>Large size, cupel.</i> . . . . .	25	8	250
9351. <i>Medium size, do.</i> . . . . .	14	5	210
9355. <b>Furnace for annealing and pressing</b> the backs of watch-cases; complete with a set of 34 cast iron plates varying from 8 to 24 lines in diameter . . . . .			75
9356. <b>Adjunction</b> of a set of 34 plates . . . . .			25

**Furnaces for plating Gold and Silver.**

	Width Centim.	Height Centim.	Depth Centim.	
9360. <i>Large size, muffle</i> . . . . .	12	10	58	325
9361. <i>Do. do.</i> . . . . .	12	7	48	260
9362. <i>Medium size, do.</i> . . . . .	9,5	5,5	48	225

Nos

Francs.

Pieces 30 centim. long, can be heated uniformly in these furnaces, which are thus very advantageous for hardening long objects such as bits, riming bits, &c.

**Assay or Cupel Furnaces.** These furnaces have the advantage of avoiding accidents and flying pieces so frequent with former furnaces.

	Width Centim.	Height Centim.	Depth Centim.	
9365. <i>Large size, muffle</i> . . . . .	12	7,5	25	230
9366. <i>Medium size, do.</i> . . . . .	10		20	215
9367. <i>Small size, do.</i> . . . . .	7		15	150

**Furnaces for burning in painting on porcelain.**

The advantages claimed for these furnaces are :

1. Great rapidity of baking, which takes place in three or four hours, instead of one day or more as required with wood or coal ;
2. The small volume of the oven ;
3. The means of regulating the temperature and of turning on a strong heat at the right moment ;
4. The means of protecting the colours against alterations produced by gases in combustion ;
5. Easy watching and handling.

	Inside Diameter Centim.	Height Centim.	
9370. <i>Large size, circular muffle</i> . . . . .	44	50	800
9371. <i>Do. square muffle</i> . . . . .	44	50	1100
9375. <i>Medium size, circular muffle</i> . . . . .	35	40	600
9376. <i>Do. square muffle</i> . . . . .	35	40	850

The muffles are vertical and provided in the upper part with a tube for the escape of gases ; to reach the muffle it is necessary to remove the cover of the stove.

**Furnaces for purifying and cleansing objects of gold and silver, with the help of diluted sulphuric acid.**

	Diameter Centim.	Depth. Centim.	
9380. <i>Large size, lead kettle</i> . . . . .	20	17	70
9381. <i>Medium size, do.</i> . . . . .	13	13	55
9382. <i>Small size, do.</i> . . . . .	7,5	7	30



Nos

Francs.

These kettles, are without seams and provided with a very wide rim, which protects the iron mounting. The furnace is fixed against the wall by means of a collar, and consumes about 300 to 500 litres of gas per day, i. e. : 10 to 20 centimes.

- 9385. *Model with tubular kettle*, 65 centim. deep for cleansing hinges . . . . . 30
- 9386. *Furnace with copper kettle* to heat water; height 17 centim., diameter 20 centim. . . . . 80

Besides these types, the Société Genevoise undertakes the making of other gas furnaces for any purpose.

- 9390. **Bunsen's Burner**, allowing an expenditure of 250 litres an hour . . . . . 4
- 9391. **Do.** with regulating cock . . . . . 7
- 9392. **Blow-Burner**, on cast iron foot (blow-pipe worked by a blower for directing at will the jet into any direction) . . . 25
- 9395. **Crucible Pliers** . . . . . 10 fr. and upwards.
- 9396. **Funnel** for crucibles . . . . . 6

**Interchangeable Parts in refractory clay.**

For melting furnaces :

	Nos	0	1	2	3	4	5	6	7	8	9	
<i>Joint-ring</i>	Fr.	20	10	—	8.50	7.50	6.50	5.75	5.—	4.—	4.—	3.50
<i>Dome</i>	»	4	2.—	1.50	1.20	1.10	1.—	80	60	60	50	
<i>Block</i>	»	4	80	80	70	60	50	50	50	50	40	

For enamelling and tempering furnaces :

				20/34	10/26	5.5/11	4/10
<i>Joint-ring</i>	. . . . .	Fr.	15	10	4.50	4.—	
<i>Muffle</i>	. . . . .	»	3	1.75	1.25	1.—	

For annealing furnaces :

For Cupel furnaces :

		Large size.	Medium size.	12/25	10/20	7/15	
<i>Joint-ring</i>	. . . . .	Fr.	13.75	10.—	7.50	6.90	6.25
<i>Cupel-muffle</i>	. . . . .	»	2.20	1.30	2.—	1.75	1.50

## § 95. Refrigerating and Ice Machines.

### Sulphurous Acid Refrigerating and Ice Machines, patented.

The principle of these machines is the continuous change of a certain quantity of sulphurous acid from a liquid state into a volatile state and conversely. The apparatus is composed of four principal and essential parts, namely :

- 1° A refrigerator, containing the sulphurous acid ;
- 2° A double action pump ;
- 3° A condenser ;
- 4° A regulating cock, for the condensed acid returning to the refrigerator.

The vapours of sulphurous acid are continuously pumped out of the refrigerator ; this change of state produces cold. The vapours are then compressed into the condenser, where the liquefaction takes place under the simultaneous effect of the compression and of the lowering of the temperature by means of circulation of water. Finally, the liquid sulphurous acid returns to the refrigerator through the regulating cock and there it is again volatilized.

The principal advantages of these machines are the following :

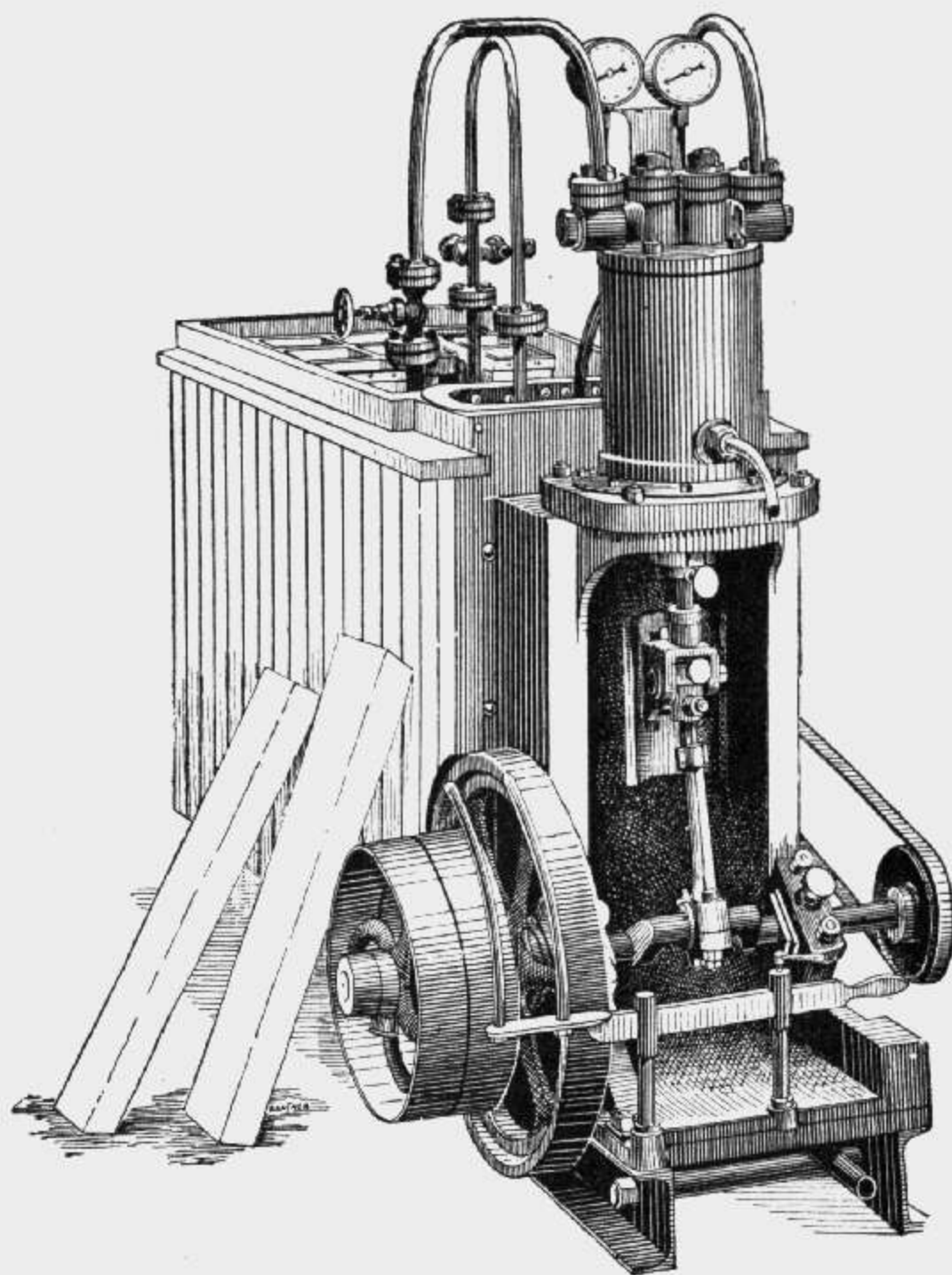
- 1° *Working at low pressure, 2 to 5 atmospheres, according to the temperature.*
- 2° *Economical production of any quantity of ice.*
- 3° *Stability of the sulphurous acid in its different states.*
- 4° *Suppression of oiling, sulphurous acid being lubricating, and without action on metals.*
- 5° *Impossibility of exploding or catching fire.*
- 6° *Consumption of acid reduced to almost nothing.*
- 7° *Easy management, requiring no apprenticeship.*
- 8° *The machine can last almost indefinitely and be easily kept in order.*
- 9° *Very small ground space required.*
- 10° *Feeding, starting and stopping instantaneous.*
- 11° *Production of ice at very low figures.*

Nos

Francs.

The Société Genevoise constructs two types of sulphurous acid machines: the *vertical type* designed for domestic use and for small concerns requiring a certain amount of ice and cold and the *horizontal type* for large establishments requiring a larger supply of ice and cold.

**Vertical Type.** The different parts of the apparatus being placed on the same framework, the machine is of a very condensed type (*fig.*) it can be shipped in one piece and in working order.



9500.

Nos

Francs.

The prices of the apparatus of this type, are as follows  
(motors not included) :

	Production per hour. Kilo.	Motive Power. HP	Consumption of water, liters.	
9500.	5	$\frac{1}{2}$	180	2350
9501.	10	1	250	3100
9502.	15	$1\frac{1}{2}$	300	3550
9503.	20	2	400	4350
9504.	25	$2\frac{1}{2}$	500	4900
9509.	50	4	800	6700

The data concerning the motive power and the consumption of water are figured for a temperature of  $10^{\circ}$  C of the condensation water. The machines are designed to be driven by belt, by direct gearing connections or by a horse mill.

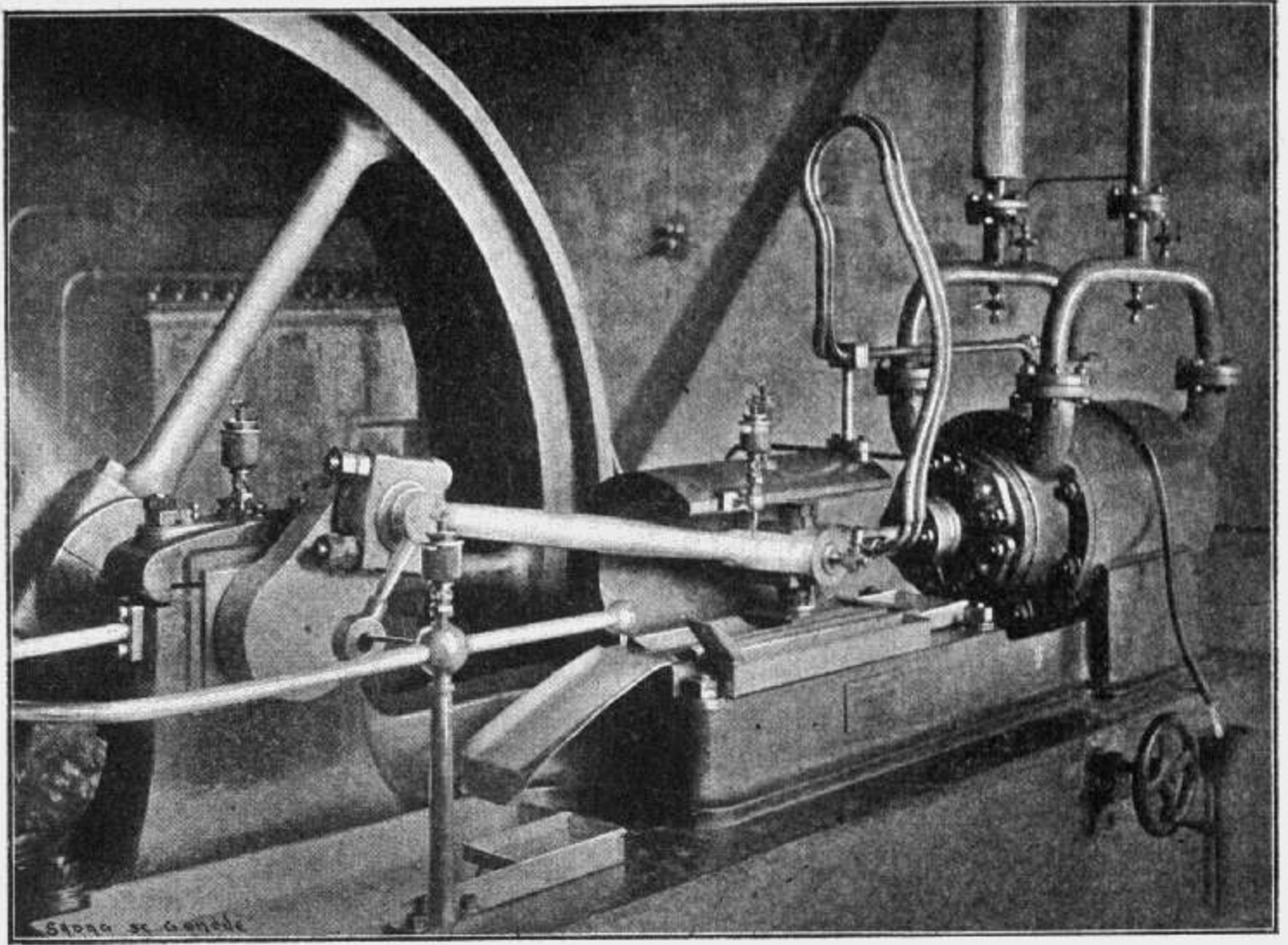
**Horizontal Type.** These types require a more considerable installation ; they are made with or without steam-motor ; the prices given below are for machines *with* motor ; they do not include the boiler nor the feeding-pump, nor the gearing and belts nor the appliances for the supply of condensation water.

The cut represents only a part of the installation (double-action pump).

9520.	Machine prod.	25 kilo. per hour,	motor without condensation	. 6550
9521.	»	50 »	» » »	. 8750
9523.	»	100 »	» » »	. 12500
9524.	»	150 »	» » »	. 15500
9525.	»	200 »	» » »	. 18500
9526.	»	250 »	» » with condensation	. 23800
9528.	»	350 »	» » »	. 29800
9530.	»	500 »	» » »	. 41400
9535.	»	1000 »	» » »	. 67000

Nos

Francs.



9520.

The prices given below are for machines *without* motor and run by a belt; they do not include the gearing and belts, nor the appliances for the supply of condensation water.

9540.	Machine	25 kilogr.	(production per hour).	. . . . .	5400
9541.	»	50	»	»	7000
9543.	»	100	»	»	9800
9544.	»	150	»	»	12400
9545.	»	200	»	»	15100
9546.	»	250	»	»	18800
9548.	»	350	»	»	24800

No.		Francs.
9550.	Machine 500 kilogr. (production per hour) . . . . .	32600
9555.	» 1000 » » » » . . . . .	54000

For further details, see special catalogue.

### 9560. **Carbonic Acid Refrigerating Machines.**

Besides sulphurous acid machines the Société Genevoise has undertaken to construct carbonic acid ice machines, with which temperatures of  $-70^{\circ}$  to  $-80^{\circ}$  are easily reached. These machines work exactly on the same principle as the sulphurous acid ones.

Carbonic acid has the great advantage of possessing a great refrigerating power and of being a gas absolutely harmless, which permits the use of these machines for domestic purposes.

The vertical type machines present a very compact model, composed of a cast iron chest, which supports the compressor and contains the coils of the condenser.

The coils of the refrigerator may be disposed for the direct expansion of the gas in the room to be cooled or it may be plunged into the salted bath containing the ice moulds.

For further details and prices, see special catalogue.

## § 96. **Hydromotors and Rotary Pumps.**

### **Hydromotors, Schmid's system.**

By their general form, these motors belong to the type of engines with oscillating cylinder; they can be employed wherever there is water under pressure.

The construction of these motors is most simple, and requires no slide valve. The distribution of water is produced by the oscillation of the cylinder, which connects alternately each end of the cylinder with the motive power, and with the out-

let. The orifices of admission are very large in proportion to the section of the piston, which facilitates the passing of the water; the speed of the piston may thus vary considerably without affecting the regular play of the motor. Here water does not act by impact but by pressure. The simplicity of the construction of these motors makes them inexpensive and less liable to getting out of order, but care must be taken not to use sandy water.

With a pressure of 30 metres, the loss due to friction in the machine is only 5%, and according to official trials made by Prof. Zeuner, at the Polytechnicum of Zurich and Prof. Thoma of the Royal Industrial School of Augsburg, the available power varies from 80 to 90%.

We guarantee an available power of 80% for a motor kept in good order.

This machine may be advantageously employed wherever there is an available pressure of at least 20 metres with the proper water-pipes; the power of the motor may also be increased by utilizing the suction of the water issuing from the motor with a fall of 8 metres at most.

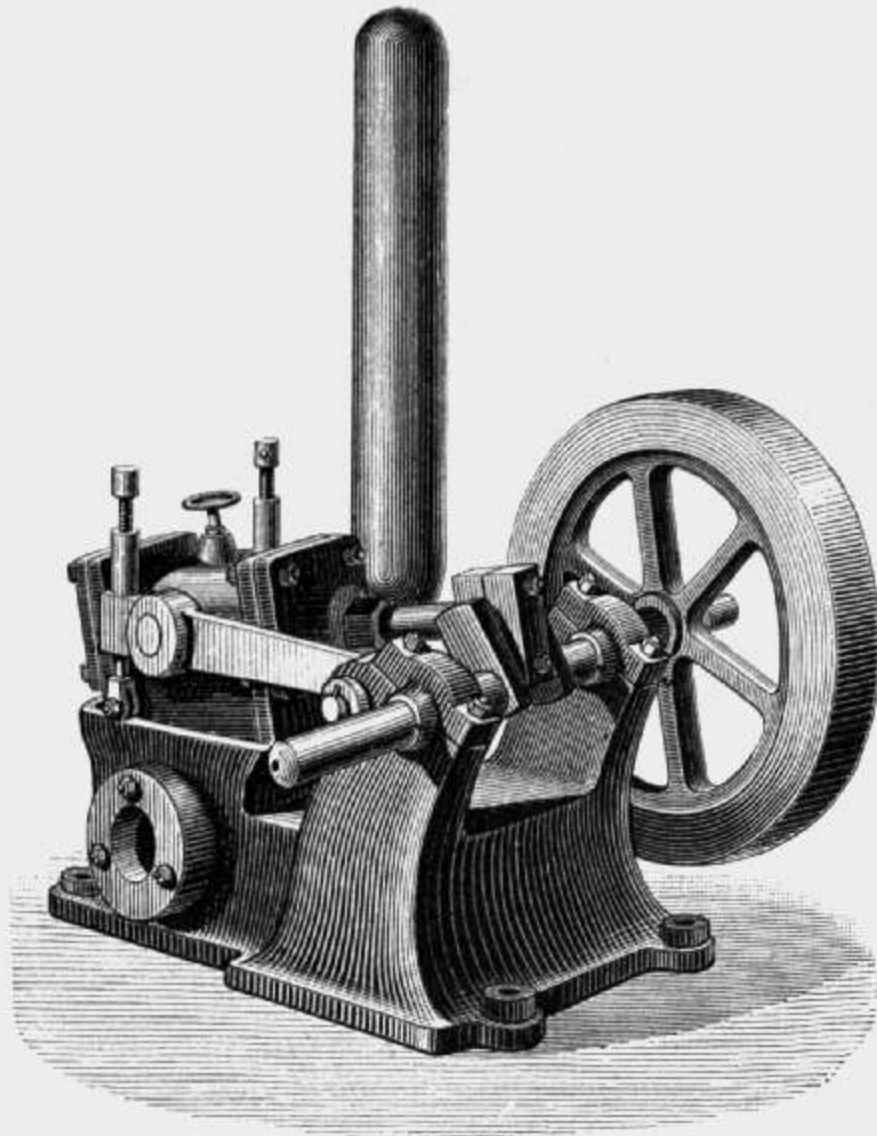
When high pressures are to be used, it is safer to couple two motors in such a manner that the two cranks will form an angle of 90°. The object of this arrangement being to regulate the power of the motor and the speed of the water in the pipes, it is a great protection against thrusts, which are much more to be feared at these high pressures. The coupled motor has also the advantage of suppressing the dead point; it starts of itself when the flood-gate is opened and its speed can be considerably altered without danger.

In towns in which there is an hydraulic service, whether by a natural water fall or by elevating machines, these motors are especially employed to drive machinery in printers', mechanics', turners' and cabinetmakers' workshops, &c. A water-meter is attached to the motor for registering, by the number of revolutions, the quantity of water employed (*fig.*).

A small model, specially designed to drive sewing machines, is also constructed, thus sparing seamstresses this toil, which

Nos

Francs.



9600.

when prolonged affects their health, as has been shown by experience.

The hydromotors can render great services not only as motors, but also as pumps, which is explained by the complete absence of valves and clapper and by the free circulation of the liquid in the machine; for this reason, the Schmid motor or pump is particularly fit for manufactures, which have to do with liquids of a thick consistence, such as breweries, sugar-works, papermills, &c. These pumps are also remarkable for the small space they take up (about one third that of ordinary pumps of the same power). It is proper to reduce the height of the column of suction and to increase the height of the compressing column.

One of the main advantages of the motor is the facility of its mounting: The motor is strongly bolted on a block of hard stone, properly secured on the ground, or even on a floor.



Nos

Francs.

To facilitate the estimation, whether of the power, or of the expenditure of water, the motors are constructed in commensurate ratios with the metrical system, i. e. : they are made so as to employ  $\frac{1}{16}$ ,  $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, 2, 3, &c. liters per revolution of the fly-wheel ; they produce a force corresponding to the quantity of water employed, multiplied by the difference of level between the motor and the water line in the reservoir.

The smallest size model contained in the following table, is made entirely of bronze ; it is much employed in chemical and physical laboratories ; the almost inoxidizable metal of which it is made fits it for this usage. The Société Genevoise also constructs, to order, larger bronze models. In laboratories and other establishments, where a great quantity of water is employed, these motors may answer a double purpose : they may serve as motors or as water meters.

In towns, where the price of water is necessarily more or less high, motors larger than those contained in the table below are no more economical. It is different when there is a natural water-fall and when the out-lay is confined to the cost of laying the pipes and installing the machine : in this case there is so to speak no limit to the dimensions of these machines. For these particular cases, special estimates will be furnished on demand.

# HYDRAULIC MOTORS (SCHMID'S System)

Constructed by the *Société Genevoise for the Construction of Physical Instruments*, GENEVA.

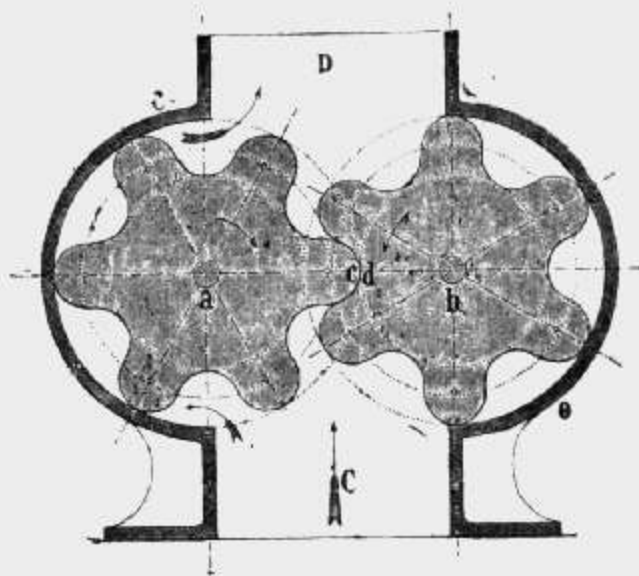
Nos	EMPLOYED AS PUMP				EMPLOYED AS MOTORS													WEIGHT		PRICES			
	DENOMINATION BY LITERS	DIMENSIONS OF CYLINDER		N <sup>o</sup> OF REVOLVS PER MINUTE	CONSUMPTION OF WATER IN LITERS	WORK IN EFFECTIVE HORSE-POWER, MACHINE WITH ONE CYLINDER AND WITH A FALL IN METRES OF													KILOS	A single cylinder		Two cylinders coupled double	
		Diameter in/mm	Path			20	30	40	50	60	70	80	90	100	120	FR.	FR.	FR.		FR.			
9600	1/16	32	40	240	15	0,06	0,08	0,11	0,14	0,17	0,20	0,225	0,26	0,28	0,34	11	275	500					
9602	1/8	40	50	240	30	0,115	0,17	0,22	0,28	0,34	0,40	0,45	0,51	0,57	0,68	22	350	650					
9604	1/4	51,5	66	240	60	0,23	0,34	0,45	0,56	0,68	0,80	0,90	1,03	1,13	1,36	44	420	790					
9606	1/2	64	80	180	90	0,34	0,51	0,68	0,85	1,02	1,19	1,36	1,53	1,70	2,04	65	525	950					
9608	1	80	100	130	130	0,49	0,73	0,98	1,23	1,47	1,71	1,96	2,20	2,45	2,94	149	630	1160					
9610	2	99	140	120	240	0,90	1,35	1,80	2,25	2,70	3,15	3,60	4,05	4,50	5,40	205	790	1420					
9612	3	108	170	120	360	1,36	2,04	2,72	3,40	4,08	4,76	5,44	6,12	6,80	8,16	280	1000	1740					
9614	4	124	175	110	440	1,66	2,50	3,32	4,15	5,00	5,81	6,64	7,47	8,30	10,00	350	1050	1790					

## ACCESSORIES

	Denomination by liters	1/16	1/8	1/4	1/2	2	3	4
9620. Flood-gate		Fr. 16	20	37	42	74	95	105
9630. 2 <sup>nd</sup> air-cushion before the flood-gate with water level.		»	—	63	80	116	116	116
9640. Register of revolutions : 60 francs. (Register fixed on the motor : 65 francs.)		»	—	63	80	116	116	116
9645. Speed regulator for motors of 1 liter per revolution : 250 francs.		»	—	63	80	116	116	116

**Rotary Pumps, Root's system.** This pump, which obtained a gold medal at the Paris Universal Exhibition in 1867, is well known to-day by its numerous applications. This machine may be said to have become classical; its description is to be found in all the principal works on Applied Mechanics. Here is what Reuleaux says about it in his *Kinematics* :

« This machine has been used long ago as water pump ; in 1724 Leupold describes it as being very ancient, in a work entitled : « *Machine à capsule avec deux roues mobiles, désignée par D. Becher sous le nom de Machina Pappenheimiana.* » Now, the work of Becher came out in the middle of the seventeenth century. Hence it appears that this machine may be traced back to-day more than two hundred and thirty years. We shall continue to designate it by the name of Pappenheim's pump, although it is not proved that the latter name is that of its inventor.



9650 a.

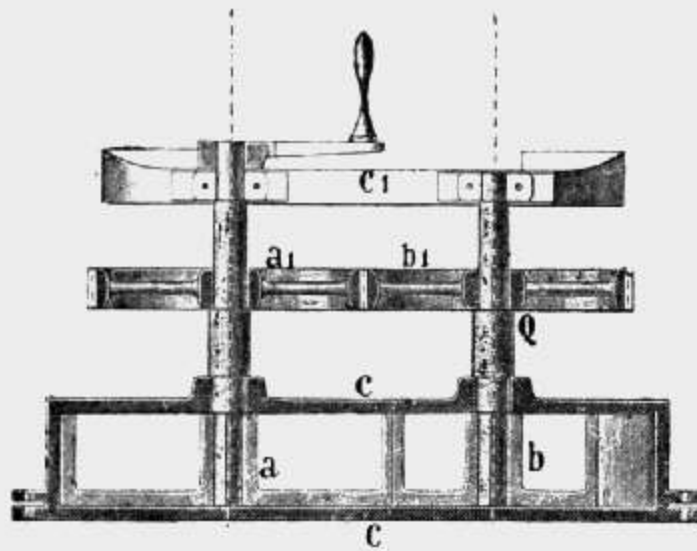
« The oldest form of this kind of capsulism is shown in the figures *a* and *b*.

« Two equal spur-wheels *a* and *b* whose teeth meet smoothly are contained in a capsule formed by two semi-

Nos

Francs.

cylindrical surfaces leaving no space between them and the outside of the teeth; on each side of the gearing line, this capsule is provided with two conduits C and D for admission and emission; it is further in contact with both sides of the wheels along their whole surface. The axles of these wheels cross in water-tight packing one of the walls of the capsule and are connected kinematically by two equal cylindrical toothed wheels  $a_1$  and  $b_1$  (*fig. b*). If one of these axles is put in motion, that of  $a$ , for instance, immediately that of  $b$  begins to move with the same speed, but in the opposite direction. If the wheels rotate in the direction indicated by the arrows (*fig. a*) and the conduits C be connected with a reservoir of water, the volume of liquid which fills the hollow part of the teeth will be carried off by the wheels  $a$  and  $b$  and brought from C to D. The contact of the teeth in the gearing position at  $cd$  being watertight, no part of the water can flow back and the liquid is completely forced away into the conduit D. We see, by this, that the machine may be utilized as a pump, and that it is well fitted for this purpose since it requires no valve and since all its parts possess a rotary motion.



9650 b.

« The shapes of the teeth of  $a$  and  $b$  may be easily determined in such a way that the contact will always take place at least in one point in the neighbourhood of  $cd$  and so that this point will remain constantly on the outline of each wheel.

This condition is satisfied by the shape of teeth shown in the figure and, in this case, no part of the water can come back from D to C by passing between *a* and *b*. The volume of water displaced is proportional to the angular velocity of the wheels. If the velocity be uniform, the volume of water supplied by D is constant; for this reason, the machine may very properly be used as fire engine.

« The volume of water displaced, by a complete rotation, is equal to the sum of the volumes of the hollow spaces between the teeth of each wheel, and, as in this case the hollow spaces are about equal to the space occupied by the teeth, we may say that *this volume is approximately equivalent to the volume of the ring comprised between the two cylinders limited at the apices and at the feet of the teeth, for ONE wheel*. This volume may be designated, by abbreviation under the name of *volume of the toothed ring*.

« Hence, to increase the supply of water, it is sufficient to increase the thickness of the wheels *a* and *b* without altering their diameter. With a sufficiently careful workmanship, the loss of water becomes negligible, especially if the pressure is not too considerable and if the rapidity of rotation of the wheels is sufficient. The preceding contrivance may then in certain cases, give very good results as a water pump.

« A third application, intermediary to the two preceding ones, is the employment of the wheel capsulism as measuring apparatus, or *water meter*. It is evident that with a suitable workmanship, the number of turns made by the wheels under the action of a current of water, gives precisely the volume of water which passes through, in terms of the capacity of the toothed ring.

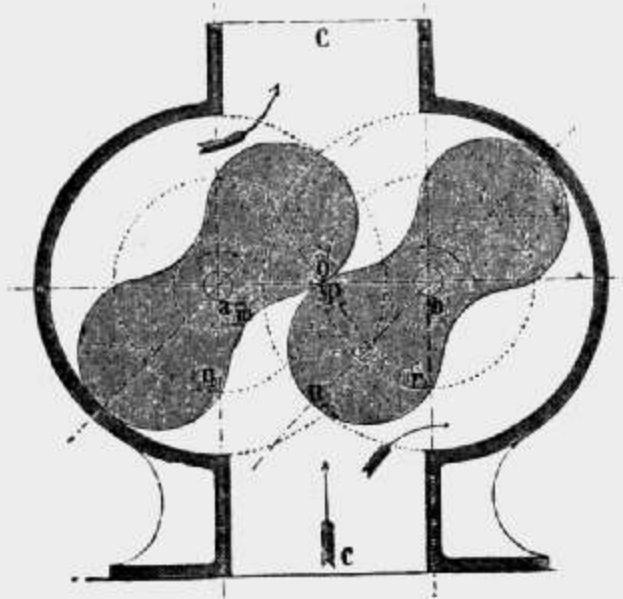
« The same capsulism may be utilized as *brake* provided it be fitted with an out-flow conduit, whose section may be reduced at will. This mechanism can be worked with water or oil and constitutes a single action brake when it is supplied with a single valve; but it becomes a double action brake when supplied with two valves. With a suitable disposition of the conduits, the liquid is made to describe a closed cycle.

Nos

Francs.

In brakes of this description, contrary to what takes place in ordinary brakes with jaws, there is no special wearing part. These brakes, when so disposed as to offer resistance only in one direction of rotation, may be utilized as *Cataracts*; this sort of brake is especially advantageous when the action of the cataract is exerted on a rotatory motion.

« In conclusion, we may say that PAPPENHEIM'S wheel capsulism is susceptible of a great number of applications. Its simple form, requiring no valve, enables it to be utilized, at will, and without any modification, as a pump (ordinary or in a fire-engine) a motor machine, or a water meter. An insignificant addition, such as that of a valve, allows of its being used as a brake or a cataract. In these various functions it can very well run either with water or with some other liquid; but it may also be used with semi-fluid or simply plastic substances, i. e. : as a press for clay and as mixer; finally it may be used to set in motion gaseous fluids, such as air, coal-gas &c., at a low pressure. Rarely, indeed, does one and the same machine lend itself to so great a number of useful applications.

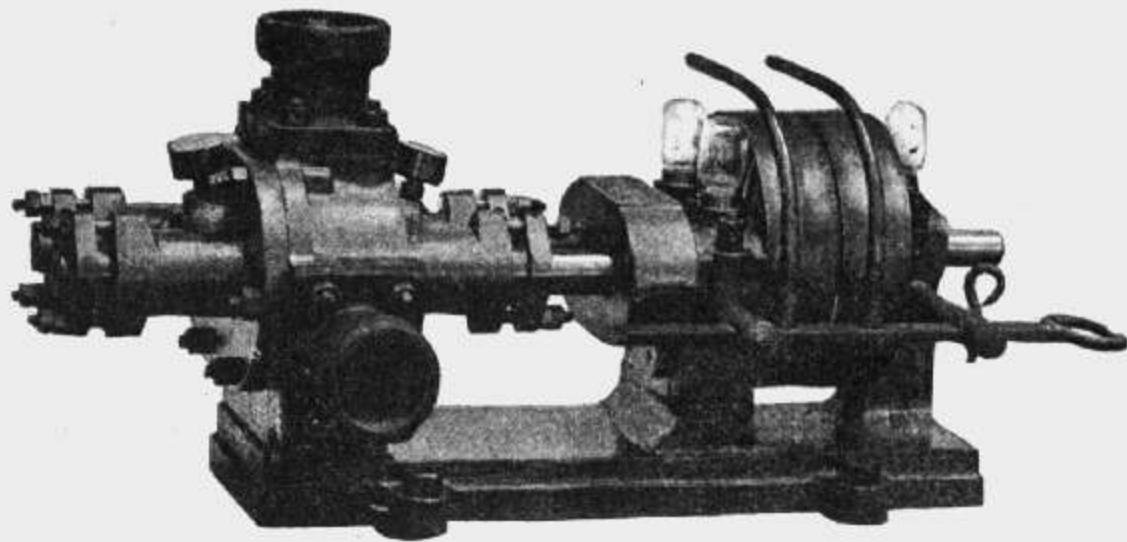


9650 c.

Nos

Francs.

Thus as Reuleaux remarks further on, the so called Root's pump (*fig. c*) is nothing else than Pappenheim's capsulism, reduced to two teeth. This pump possesses then the same advantages, it yields a uniform out-flow and furnishes at every revolution a volume of fluid sensibly equal to the volume of the toothed ring.



9650.

Roots' pumps are advantageously employed in refrigerating machines (see § 95) to cause the salt water to circulate, after coming out of the refrigerator.

Prices of Root's pumps with cast-iron support and gearing pulleys.

Nos	DISCHARGE in liters per minute.	NUMBER of revolutions per minute.	DIAMETER of the pipes mm.	Horse power per 10 metres elevation.	PULLEYS		FOUNDATIONS		PRICES	
					Diameter mm.	Width mm.	Length mm.	Width mm.	in iron Frs.	in bronze Frs.
9650	100	350	40	$\frac{1}{4}$	200	50	650	320	350	510
9652	200	350	60	$\frac{2}{5}$	220	60	700	380	450	680
9654	300	300	72	$\frac{4}{5}$	280	70	845	435	600	880
9656	500	250	100	$1\frac{1}{4}$	350	90	940	465	800	1150
9658	750	220	127	2	407	120	1120	530	1150	—
9660	1000	180	146	$2\frac{1}{2}$	520	160	1250	600	1650	—

Nos

Francs.

**Accessories.**

9665. **Rose** with valves. Price according to the dimensions of the  
 pump . . . . . 25 to 90

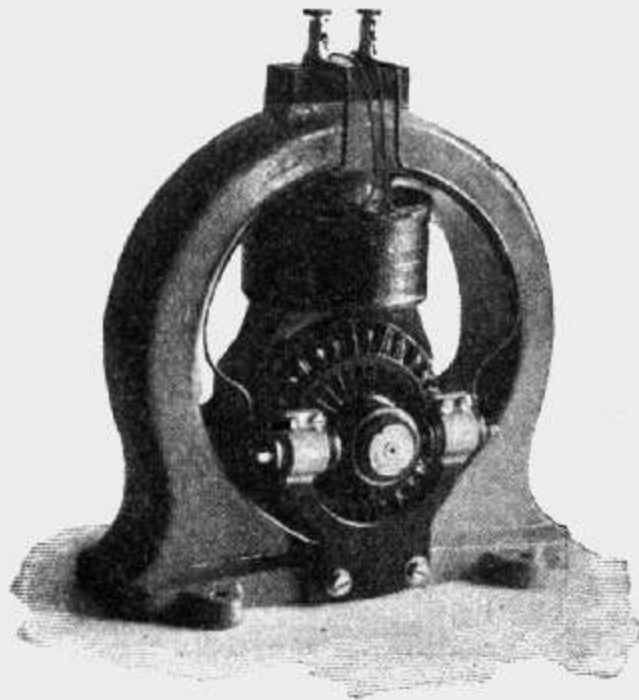
**§§ 97 and 98. Applied Electricity.****(Dynamamos, Electric Meters, Electro-Magnets)**

**Dynamo-Electric Machines (Thury's patent).** These machines are designed for physical laboratories or for industrial purposes, ice-making machines, &c.

**Direct Current Machines with radiating Poles.**

These machines are recommended on account of their simplicity and cheapness. All their parts are very accessible and can be kept very clean.

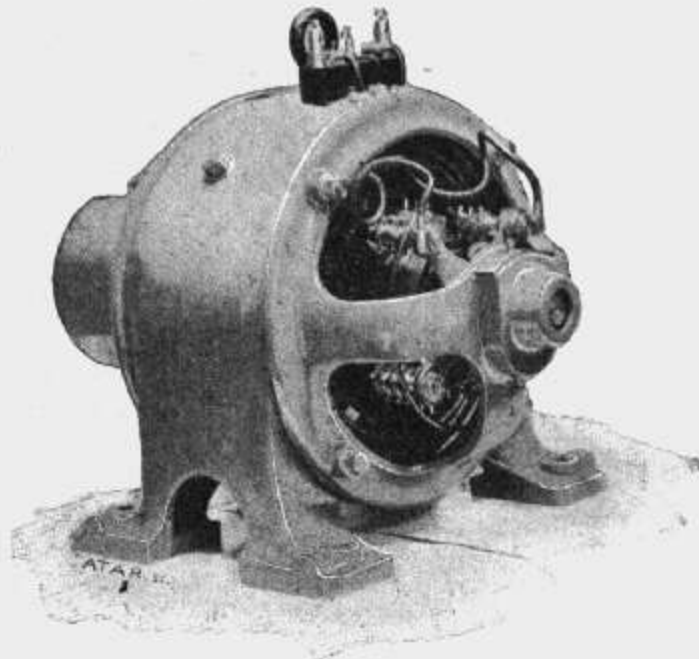
They combine all the advantages of solidity, elasticity, simplicity and durability (*fig.*).



9700 à 9706.



Nos	Type	MOTOR		PULLEY Diameter of the 3 grooves, cm.	DIMENSIONS in centimeter	WEIGHT		Francs.
		Maxim. HP.	Approx. Velocity			kilog.		
9700	PR 1	$\frac{1}{20}$	3000	2-3-4	20×18×12	10		225
9702	PR 2	$\frac{1}{10}$	2500	2-3-4	22×21×13	15		260
9704	PR 3	$\frac{1}{6}$	2250	2,5-3,5-4,5	27×25×14	20		325
9706	PR 4	$\frac{3}{4}$	2000	8 5	37×35×36	40		550



9710 to 9722.

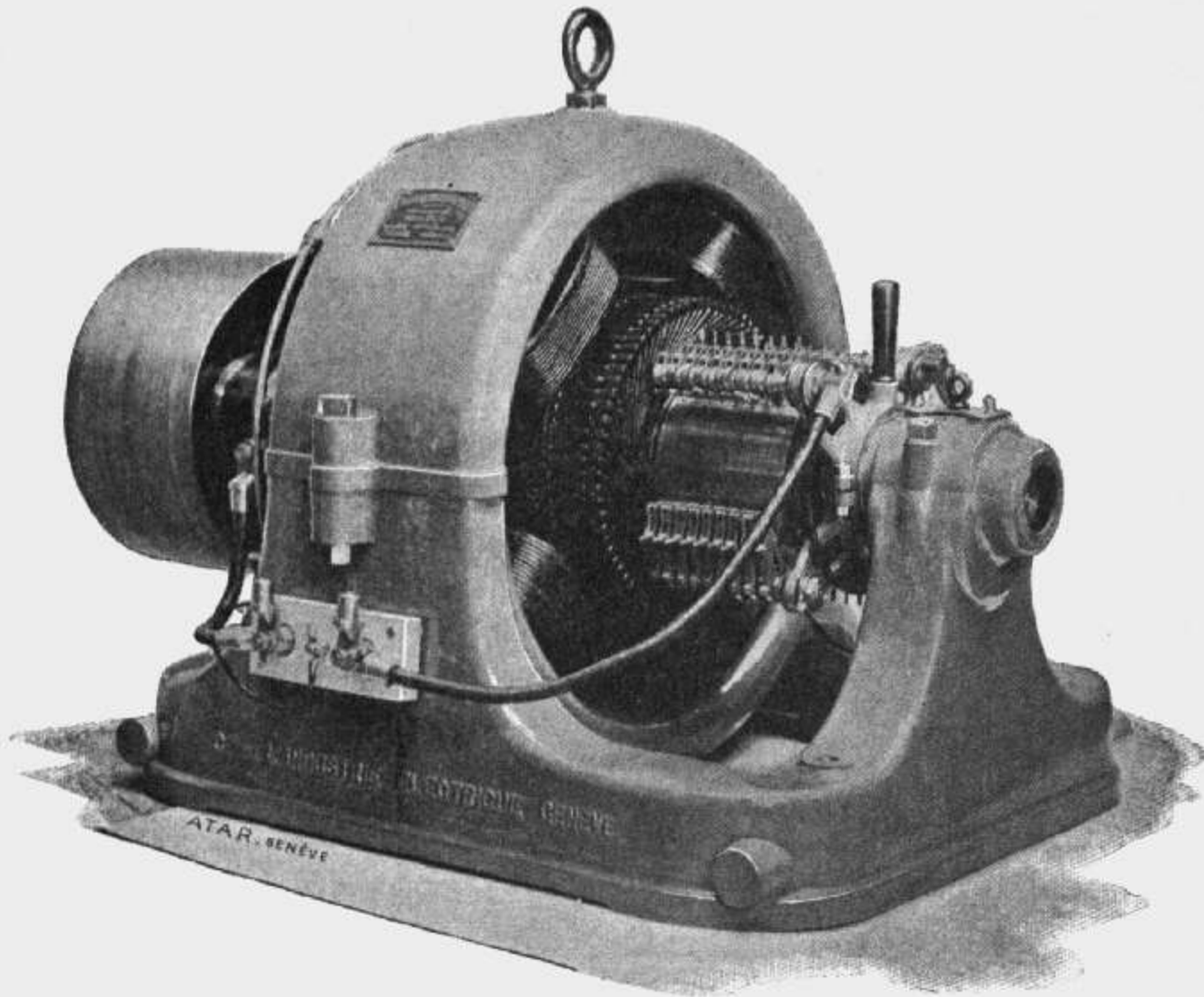
				diam.	width				
9710	PR 5	1	1800	10	6,5	43×41×44	80		655
9712	PR 6	2	1600	12	8	49×45×48	150		865
9714	PR 7	3	1400	12	9	56×54×54	230		1020
9716	PR 8	5	1250	15	11,5	64×62×66	310		1210
9718	PR 9	7	1120	20	14	66×65×67	390		1440
9720	PR 10	10	1000	23	14	66×66×75	470		1770
9722	PR 11	15	1000	25	15	66×66×78	530		2150
9730	PR 12	25	850						
9732	PR 13	35	850						

The above prices comprise the complete machine with its starting gears, sliders and sole plate bolts.

For tensions inferior to 100 volts and superior to 150 volts, these prices may be increased proportionally.

Nos

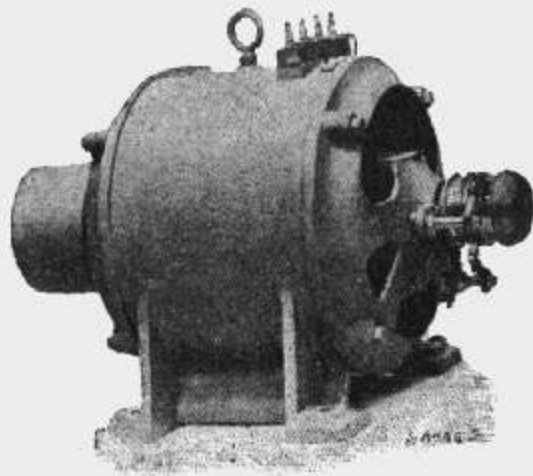
Francs.



9730 to 9732.

**Alternative current Machines. Asynchronous motors, bi and triphased.**

These motors are constructed with the greatest care. They meet all requirements of good running and security imposed by the central stations. Up to 3 horse power, the starting is



9740 to 9782.

Nos

Francs.

effected by a simple interrupter. For higher types, a special starting apparatus with chemical resistance is used, which is inserted in the inducted circuit; the motors thus start under charge without absorbing a current superior to that of the full charge (*fig.*).

*Motors with short circuit induction.*

	Type	MOTORS		PULLEY		DIMENSIONS in centimetres	WEIGHT kilog.	Normal	
		Max. H. P.	50 periods approx. veloc.	diam. of the 3 grooves, cm.	diam. width			maxim. Voltage	
9740	MA 1	$\frac{1}{10}$	2800	3-2,5-2		18×15×10	10	110	180
9742	MA 2	$\frac{1}{4}$	2800	8	4	19×19×22	30	110	300
9744	MA 3	$\frac{1}{2}$	1440	8	4	23×19×22	40	150	350
9746	MA 4	$\frac{3}{4}$	»	8	6	32×27×43	55	200	400
9748	MA 5	1,5	»	12	8	40×35×40	96	200	660
9750	MA 6	2,5	»	12	8	49×35×40	140	250	810
9752	MA 7	3,5	»	15	11,5	57×42×51	195	250	950

*Model with reeled induction.*

9760	MA 7	3,5	1440	15	11,5	70×42×51	225	250	1100
9762	MA 8	5	»	22	14	77×42×51	350	250	1200
9764	MA 9	8	»	22	14	83×50×60	350	250	1360
9766	MA 10	10	»	22	14	86×50×60	400	300	1535
9768	MA 11	13	»	25	15	93×56×71	535	350	1920
9770	MA 12	17	»	25	15	97×56×71	575	350	2220
9772	MA 13	22	»	28	16	113×64×77	700	400	2790
9774	MA 14	28	970	30	17	139×75×92	810	500	3420
9776	MA 15	45	»	35	24	137×95×110	1900	»	4940
9778	MA 16	55	725	45	30	155×95×110	2300	»	5800
9780	MA 20	90	»	40	40	142×113×135	3076	»	8250
9782	MA 21	110	»	55	40	143×113×135	3300	»	9500

The above prices are understood for the normal voltage as indicated in the last column, and include the complete machine with its starting gear and slider.

For higher voltages, they may be increased from 5 to 20% according to the cases.

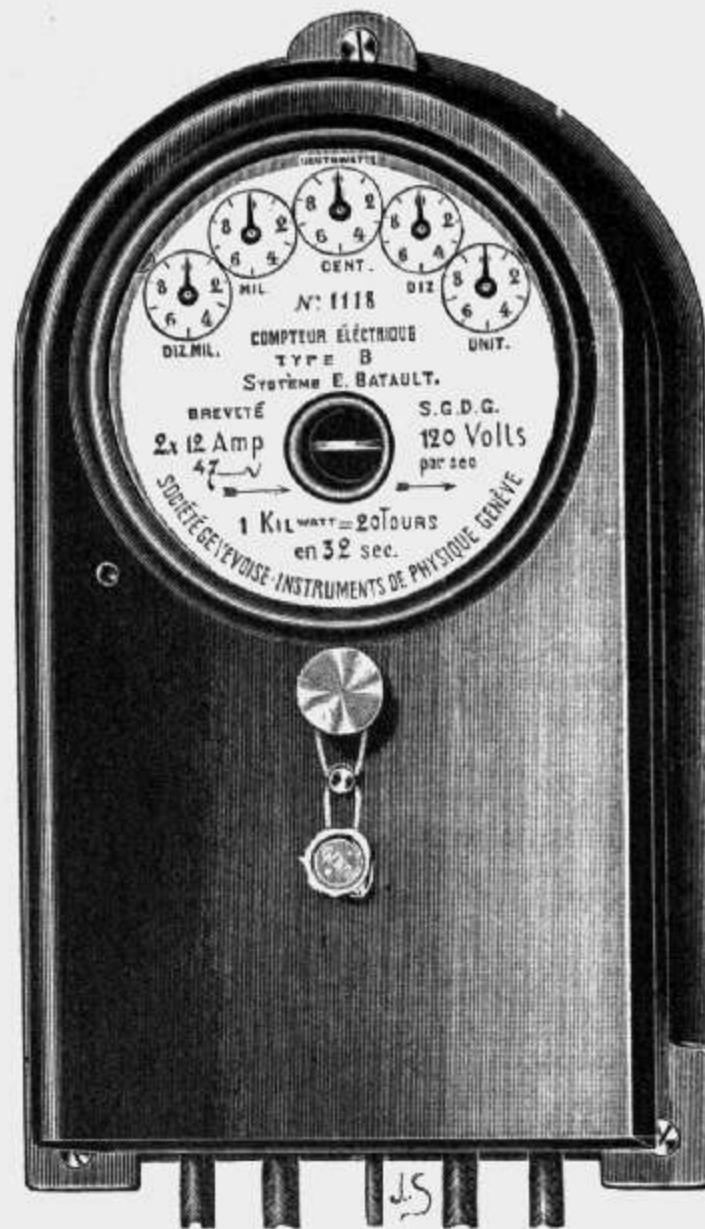
### **Electric Meters « Simplex ».** **Batault's System, patented.**

The Batault's meter is an integrating wattmeter for measuring the alternative current; it possesses the following advantages:

1. Great simplicity from the electric and mechanical point of view;
2. Proportionality in the whole scale of loads whatever be the power factor of the current measured;
3. Great sensibility in the start and sure stopping; no motion by itself;
4. Absence of any collector or contact; no appreciable wear;
5. Requires scarcely any attention; easy to regulate and verify; noiseless apparatus; practical closing;
6. Insignificant expenditure of energy;
7. Very moderate prices.

The meter is a small and very simple motor driven by the current to be measured (*fig. b. and c*). The moving part is composed of a very light aluminium disc *L* mounted on a vertical axis and influenced by several alternative fields of different phases.

The axis pivots on a sapphire; it is absolutely free from any electric contact and from any friction; the only resistance to be overcome is that of the wheel counter. The motor fields act on the disc by induction; they are produced by a special electro-magnetic combination, sort of transformer composed of three coils *Z*, *N* and *O* placed on two sheet iron horse-shoes *K*, and separated from each other by a thin non metallic plate, which does not extend as far as the extremities of the horse-shoes and thus leaves a free space between them. The two horse shoes are submitted to the influence of the coils *N* traversed by the derived current. The principal coil in series *Z*, crossed by the current to be measured, near its free extremities, is fixed on one of the horse-shoes. The third derived coil is made of plain copper rings *O*, surrounding the upper parts of the horse-shoes without being in contact with them.



9810 a.

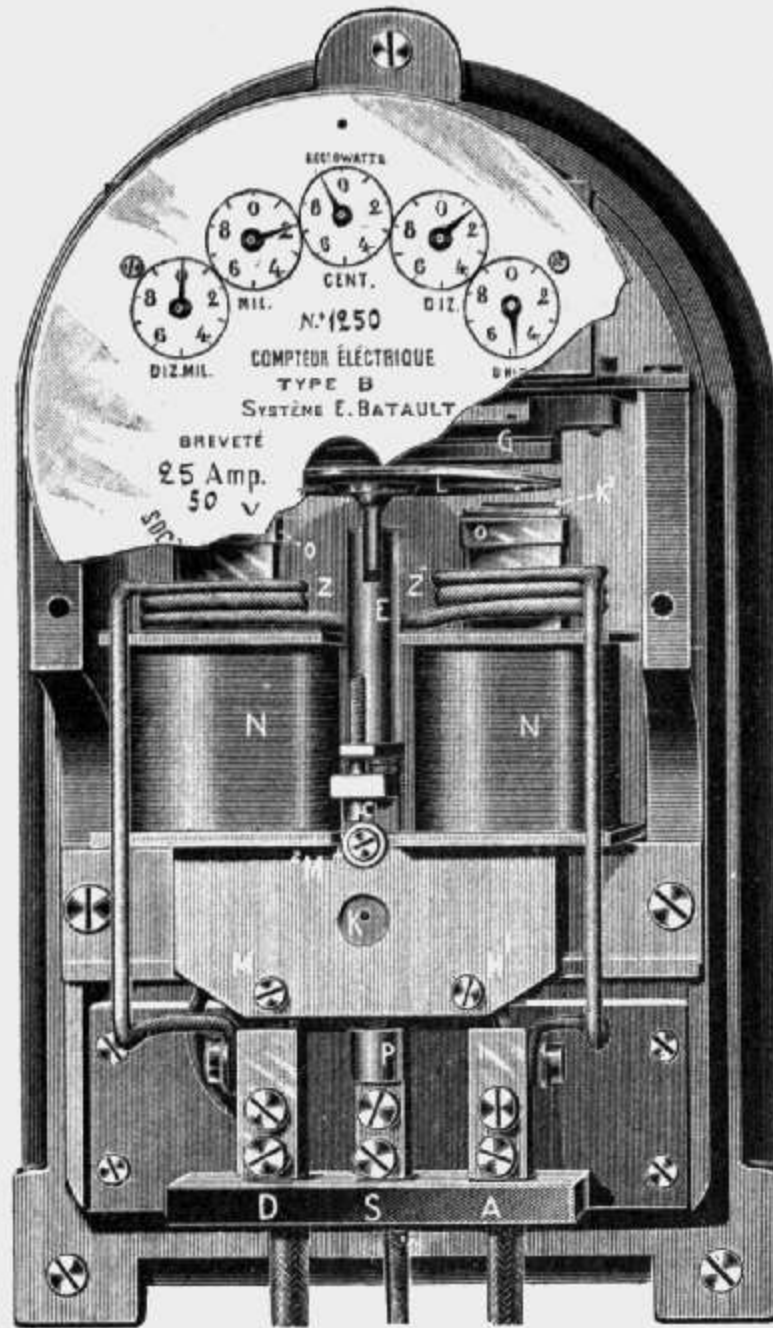
The fields resulting from this magnetic combination are such that the speed of the motor is proportional to the watts passing through it, whatever may be the power factor of the current measured. These fields, producing a torque, may also serve as brakes.

The posterior horse-shoe is screwed into the frame and its distance to the disc is invariable. On the other hand, the anterior horse-shoe, bearing the coils in series can move vertically to allow of regulating the constant of the meter; the constant of the apparatus can thus be modified with great facility.

Above the disc and parallel to it, is an iron armature *G*, pivoted concentrically with the axis of the disc and located in

Nos

Francs.



9810 b.

front of the space separating the horse-shoes. With this armature, the perfect proportionality of the meter can be established for the whole scale of loads; it also prevents any running at no load.

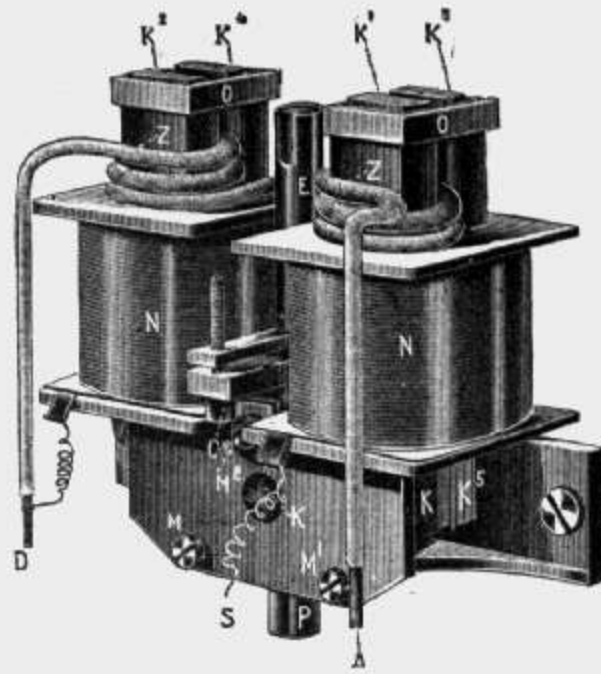
The Society makes two principal types of electric meters: the *constant potential type* and the *variable potential type*.

**Constant potential type** (called *type B*). This type is a wattmeter gauged so as to run with the mean normal voltage of the distributing station. It is correct whatever may be the load of the current measured, but it is regulated for a constant pressure. It has the advantage of containing no permanent magnet nor any other variable element.

Nos

Francs.

The Society has a present fifteen hundred meters at work, giving entire satisfaction. Prices :



9810 c.

9800.	Small model for a constant potential inferior to 150 volts (type Bd) and for currents of 6 amp. . . . .	88
9801.	Do. for currents of 12 amp. . . . .	100
9810.	Large model (type B) for constant potential inferior to 150 volts and for currents of 26 amperes (fig. a, b and c) . . . . .	130
9811.	Do. for currents of 2×12 amperes . . . . .	140
9812.	Do. " 50 " . . . . .	150
9813.	Do. " 75 " . . . . .	160
9814.	Do. " 2×35 " . . . . .	170
9815.	Do. " 100 " . . . . .	170
9816.	Do. " 200 " . . . . .	
9817.	Do. " 300 " . . . . .	

**Variable Potential Type** (called *Type C*). This type is a wattmeter presenting a greater guarantee of constancy than any other similar apparatus. It differs from the constant potential type only by the addition of a brake consisting in a permanent magnet; special precautions have, moreover been taken to secure this brake as invariable an action as possible.

9820.	Small model for a variable potential inferior to 150 volts (type Cd) and for currents of 6 amp. . . . .	94
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Nos		Francs.
9821.	<i>Do.</i> for currents of 12 amp. . . . .	106
9830.	<i>Large model (type C) for variable potential inferior to 150 volts and for currents of 25 amp. . . . .</i>	140
9831.	<i>Do.</i> for currents of 2×12 amperes . . . . .	150
9832.	<i>Do.</i> " 50 " . . . . .	160
9833.	<i>Do.</i> " 75 " . . . . .	170
9834.	<i>Do.</i> " 2×35 " . . . . .	180
9835.	<i>Do.</i> " 100 " . . . . .	180
9836.	<i>Do.</i> " 200 " . . . . .	
9837.	<i>Do.</i> " 300 " . . . . .	
9840.	<i>Large model, for variable potential comprised between 1000 and 3000 volts and for currents of 200 amp.; with transformer .</i>	
9841.	<i>Do.</i> for currents of 300 amperes . . . . .	

#### Accessories :

9850.	<b>Transformer</b> for high tension currents (1000 to 3000 volts) . . . . .	130 to 150
9855.	<b>Inductive Resistance</b> for tensions between 400 and 600 volts . . . . .	62

*For more details, see special catalogue.*

### Prof. H. Du Bois' Electro-Magnets.

The arms of the magnet, shaped like arcs of a circle are bolted on a very stable cast-iron base, in such a manner that they can be brought together or separated. An interval of about 50 millim. can thus be obtained between the poles when these are fitted with polar garnitures or of 100 millim. without these garnitures. The latter are cylindrical or conical and are fixed by a sort of bayonet joint; they are easily taken out and changed. The small table standing between the arms of the magnet can be moved vertically and sideways (*fig.*).

The holes through which the iron cylinders *c* can slide, are used for optical experiments.

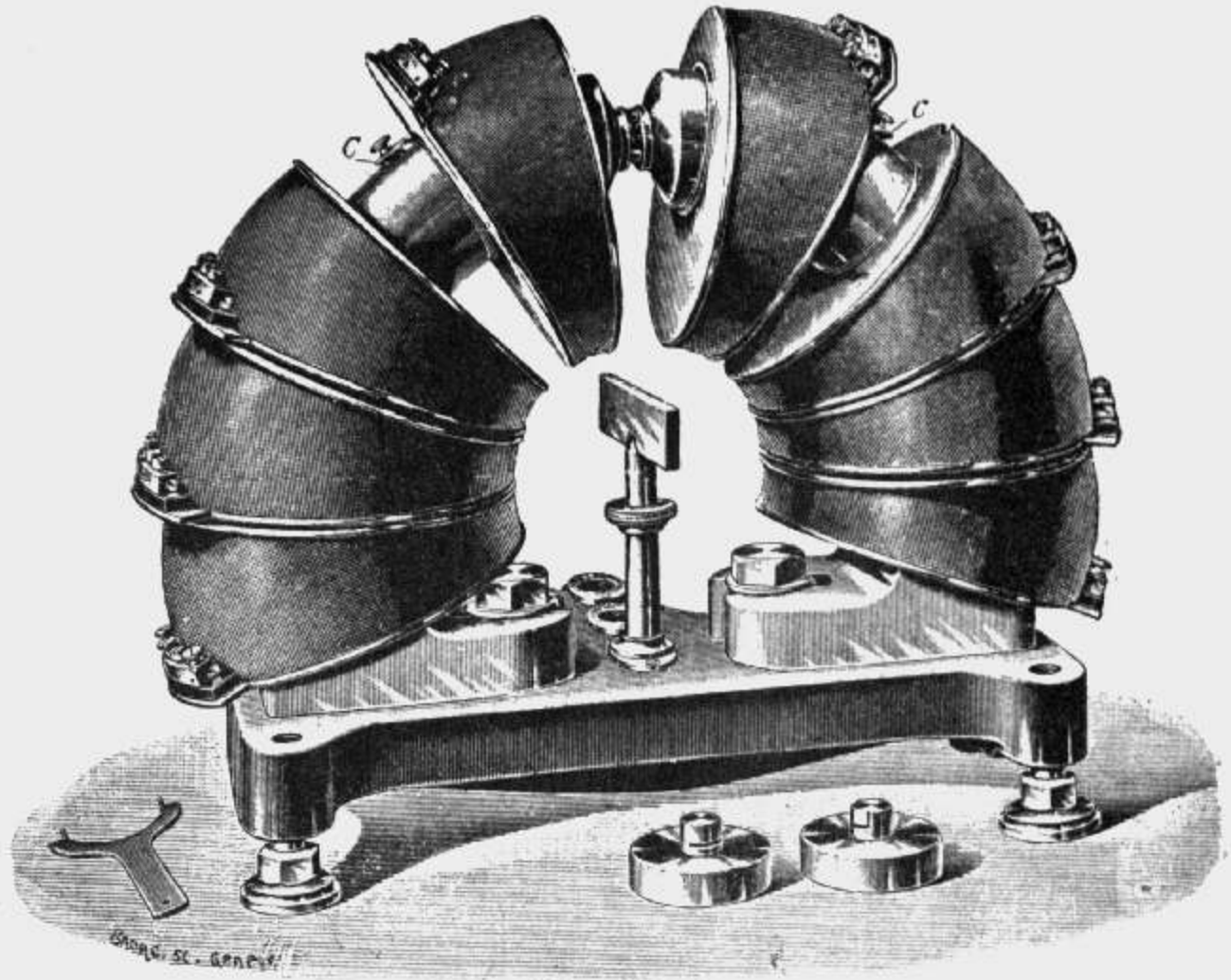
By uniting the eight coils in tension the wire counts 2500 turns forming a total resistance of about 3,6 Ohms, calculated



Nos

Francs.

for a maximum current of 20 Amp. By using conical polar garnitures whose extremities had about 33 square millim. of



9870.

section and were fixed 1 millim. apart, the following preliminary results were obtained :

Volts.	Ampères.	Amp. revolutions.	Power of the field. in c. g. s.
18	5	12,500	30,700
36	10	25,000	33,000
54	15	37,000	34,000
72	20	50,000	35 to 38,000

9870. Price of the electro-magnet with polar cylindric and conic garnitures, large model. . . . . 1750

For smaller models, prices on application according to dimensions.

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