

**IMPROVEMENTS MADE TO PLUMB BOBS BY THE MINING INDUSTRY
AND AMERICAN AND GERMAN MINING PLUMMETS.**

See also: PATENTED MINING PLUMMETS in the WOLF'S PATENT NEWS 2007-15 and 2007-17.
Articles now available for download on my new website, www.plumbbob.de

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1. INTRODUCTION

In order to survey „UNDER GROUND“ the measurements and coordinates of the surface of the earth have to be brought down through a shaft or shafts to the mining level. Plumb bobs are employed to transfer map points at the surface to the mining levels below. This is known as „Shaft Shift Plumbing“ using two plumb bobs hanging as far apart as possible, in one shaft. The plumb lines give the surveyor two points and the first direction vector from which to establish a map grid to survey a mining tunnel system. Due to the extreme depths of the shafts and the damp and dark working environment, certain improvements were made to the simple plumb bob so that surveyors could map the shafts, galleries and adits in absolute darkness as if they were on the surface of the earth. This is no small challenge when you think of hanging a plumb bob from hundreds of feet of plumb line. Additionally, before the use of electricity to light and ventilate mines, making enough light to see a point at a distance through the optics of a surveyors instrument was a serious challenge.

xciiij

Vom Bergwerck

Zoch A. Der stab des jochs B. Schacht C. Die erste schnür D. Das gleich der ersten schnür E. Die andere schnür F. Eben die selbige in die erden gehesset G. Der ersten schnür Knopff H. Das mundloch des stollens I. Die dritte schnür K. Das gewicht der dritten schnür L. Das erst meß M. Das ander meß N. Das dritt meß O. Der triangell. P.



AGRICOLA „VOM BERGWERCK XII BÜCHER“ 1557

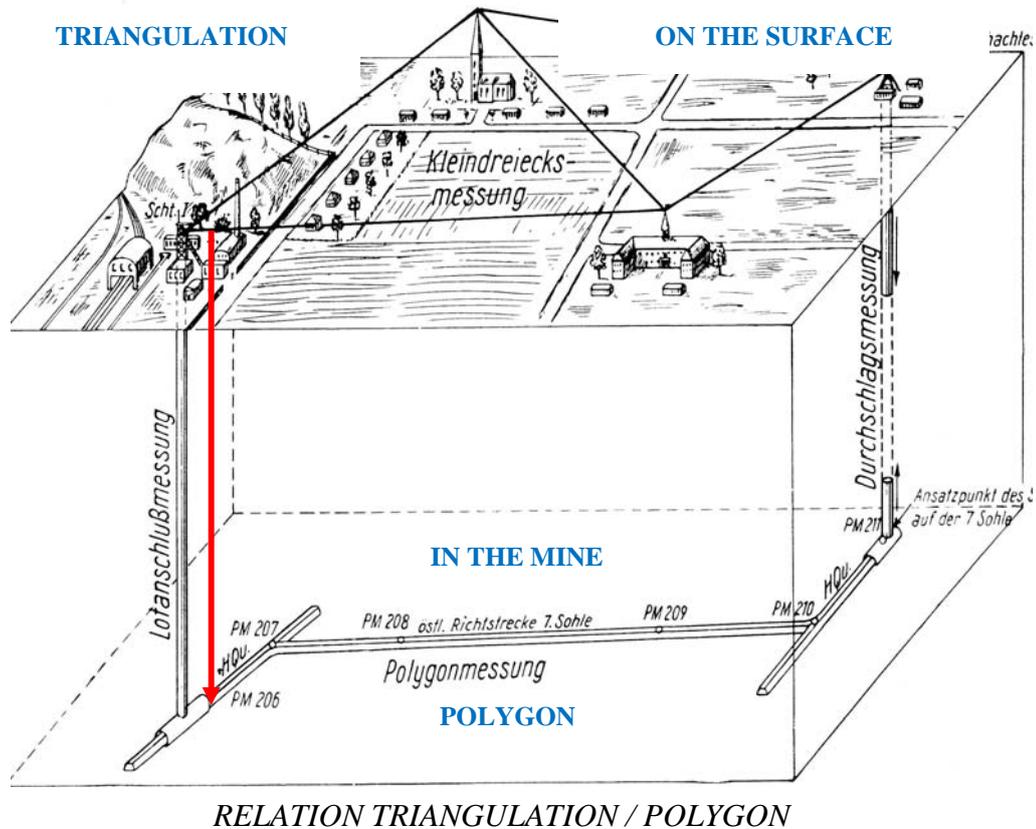
In mining, plumb bobs are used in two distinctly different ways:

- **PLUMBING DOWN A SHAFT.** Coordinates are transferred from the surface map grid to establish the start point for a coordinating map grid at any level of the mine. Thus the plumb line is the dominant feature and the plumb bob a simple weight.
- **SURVEYING** the tunnels, adits and galleries requires laying out, measuring and marking, many points in many directions from the point of origin, the shaft. These points would mark significant bends and or changes in elevation in the tunneling. As these points were set out and recorded by the surveyor a specialized plumb bob, “plummet,” was employed as a target for the surveying instrument. Before electrical illumination, self illumination was a key feature of the “plummet.”

Here’s a brain teaser for the curious reader: TAMARACK MINES, U.S.A. It was recorded that the distance between two plumb lines hung down a shaft in Tamarack Mine were closer to each other at the surface than they were at the bottom of the mine. Why?

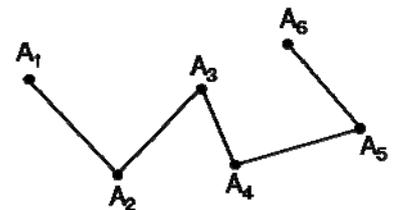
See: The Tamarack Mines Mystery

<http://www.lhup.edu/~dsimanek/hollow/tamarack.htm>



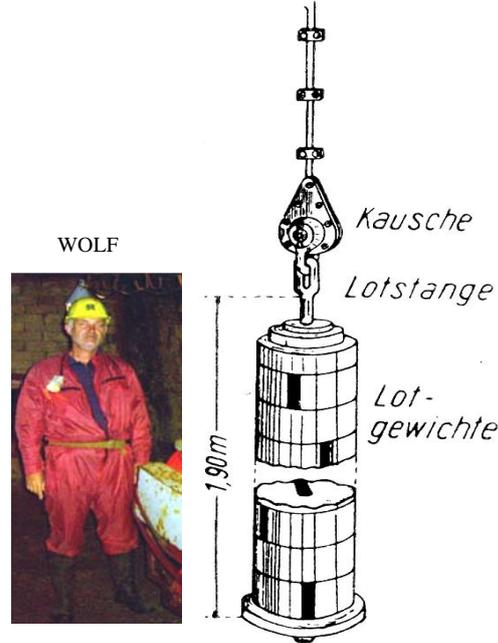
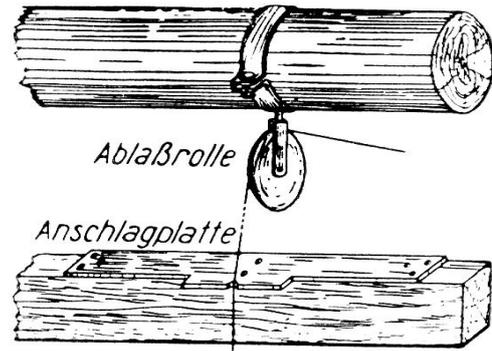
The reference points on the surface are found by TRIANGULATION. To know the correct position underground you must transfer reference points from surface mapping down in the mine tunnel system. At that level POLYGON measuring is used to establish points along the tunnels.

WIKIPEDIA says: A **polygonal chain**, **polygonal curve**, **polygonal path**, or **piecewise linear curve**, is a connected series of **line segments**. More formally, a polygonal chain P is a curve specified by a sequence of points (A_1, A_2, \dots, A_n) called its **vertices** so that the curve consists of the line segments connecting the consecutive vertices. A **simple polygonal chain** is one in which only consecutive (or the first and the last) segments intersect and only at their endpoints.



Picture below:

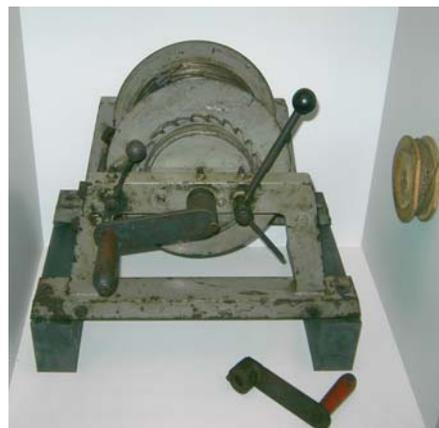
Head of a mining plummet of 125 kg, produced by Gampper Germany for mines in Finland and Russia. Compare it with an original head (screw) of a usual German 1 pound plumb bob.



This type of plumb bob weight (right) is not part of my collection ☺

BIG PLUMB BOB WEIGHT
IN A SHAFT

Pictures below: The winder with a braided steel cable was driven by hand or power and was further protected by ratchet mechanisms to control the weight as it was dropped. Extruded, single wire strands, would kink, bend and break. Special precautions are needed to safely drop, then suspend heavy weights as the surveyors work below ground.



MEASURING CHAIN

2. MINE SURVEYORS AT WORK

Some photos, drawings and pictures show the problems of the mine surveyors in a small, dark and damp mine gallery. Open flame lamps or candles provide illumination in an environment that could be explosive with mining dust or trapped combustible gasses.

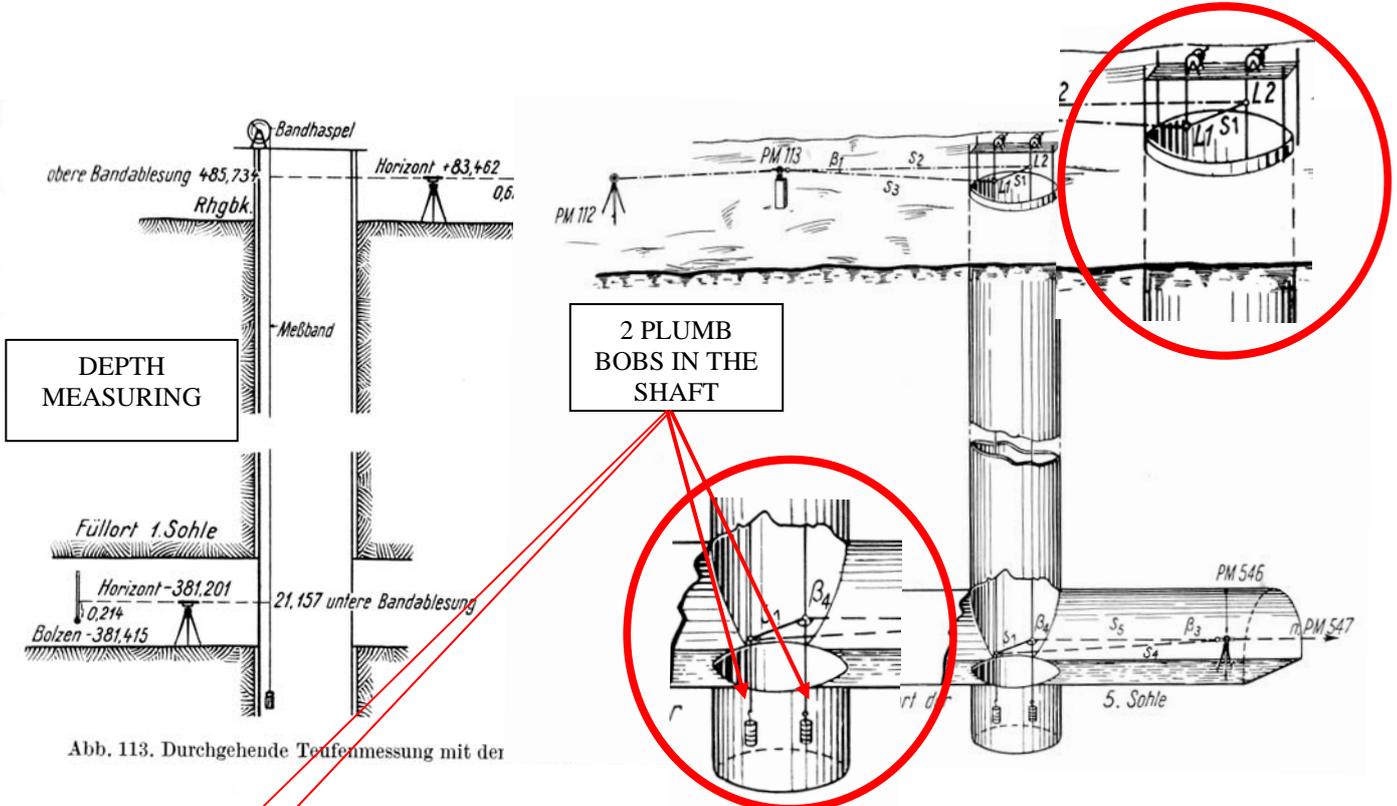
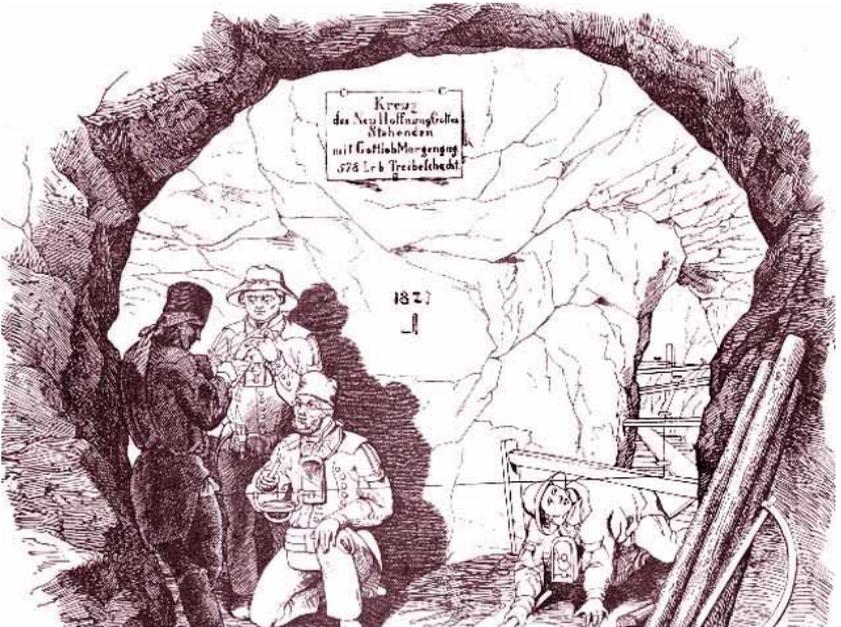


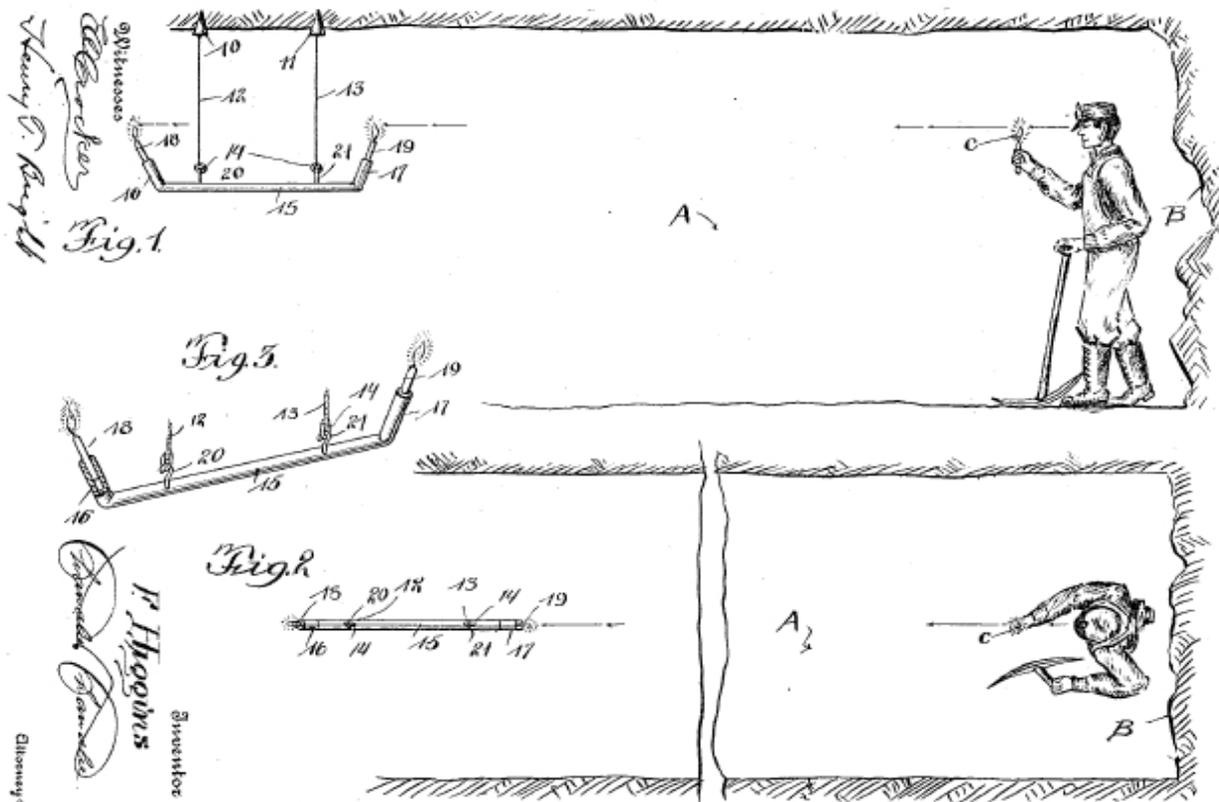
Abb. 113. Durchgehende Tiefenmessung mit der



2 PLUMB BOBS IN A WATER BUCKET (to reduce the oscillation)



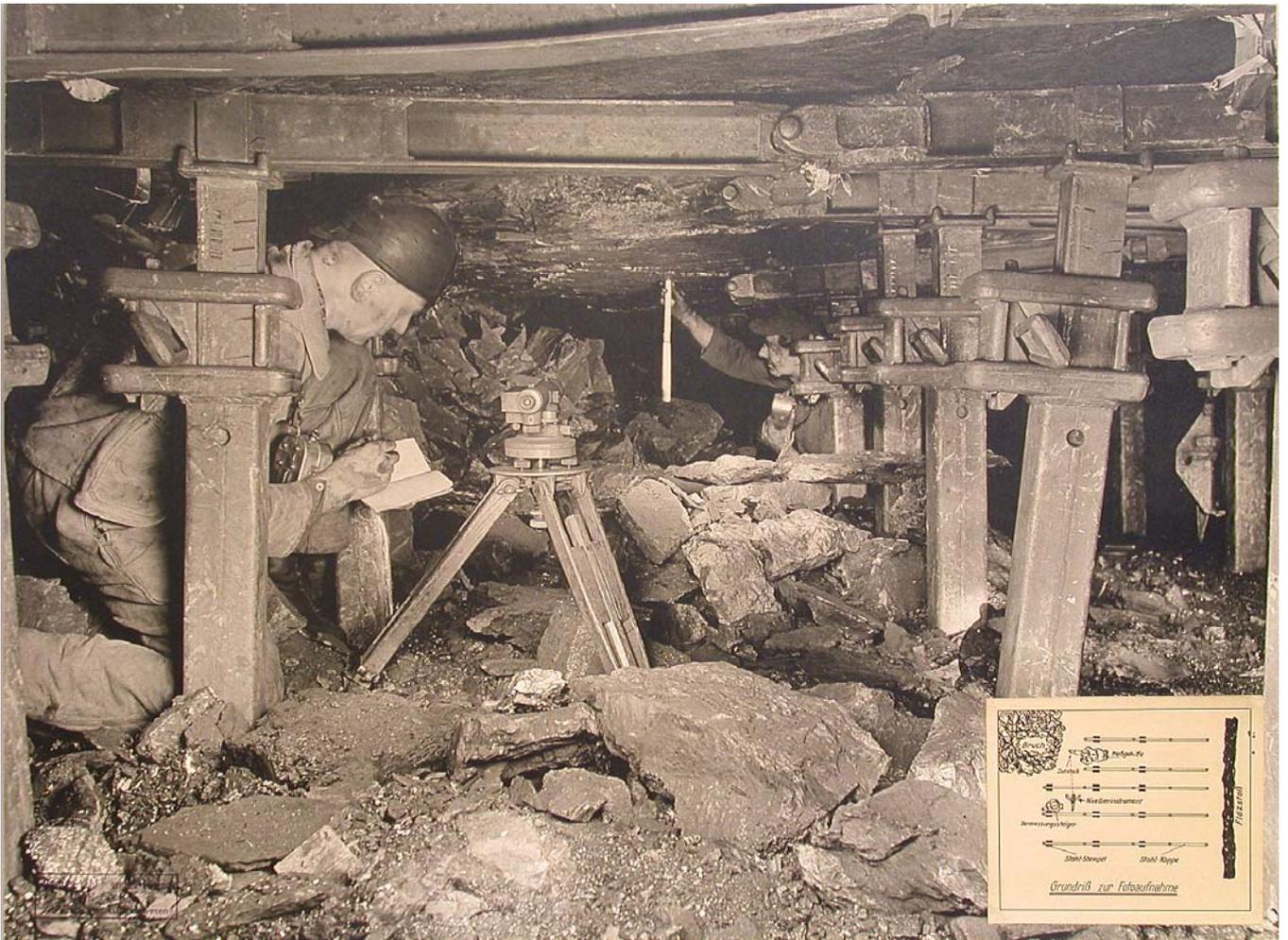
MINE SURVEYORS 1851. Drawing Johann Eduard Heuchler, Freiberg



1,081,829.
F. HIGGINS,
SIGHTING TARGET.
APPLICATOR FILED JUNE 17, 1913.
Patented Dec. 16, 1913.



MINE SURVEYORS AT WORK. Oil painting Francois Ignace Bonhommé ca. 1850;
Origin: Deutsches Bergbau-Museum/Montanhistorisches Dokumentationszentrum/Museale Sammlungen, Bochum
Germany [Fotothek # 033303732000] www.bergbaumuseum.de :



THE HARD WORK IN A VERY NARROW PART OF THE MINE. Photo c 1950/60.

Origin: Deutsches Bergbau-Museum/Montanhistorisches Dokumentationszentrum/Museale Sammlungen, Bochum Germany [Fotothek # 024200011000] www.bergbaumuseum.de :

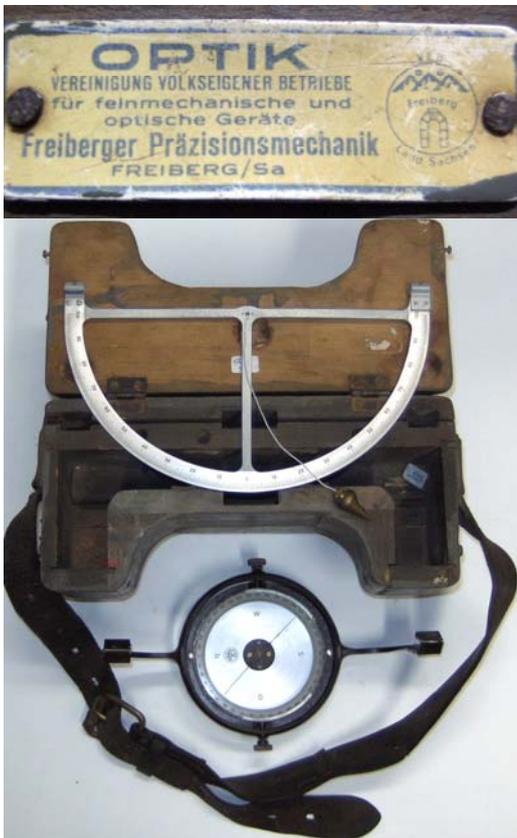
A fondly remembered personal find from an abandoned TIN MINE in the eastern part of Germany (Ehrenfriedersberg / Erzgebirge) still some hooks for plumb bobs and a level.



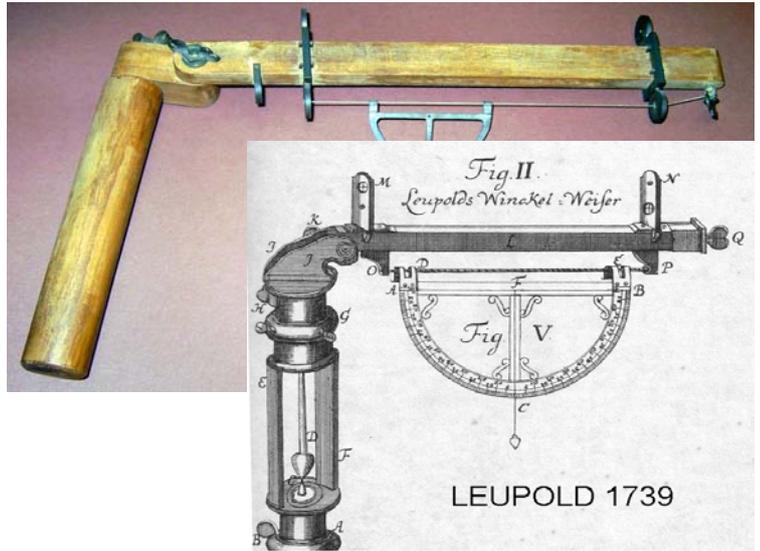
3. GERMAN MINING MUSEUM /DEUTSCHES BERGBAU MUSEUM Bochum

At the end of 2008, I got the chance to visit the archive of the German Mining Museum in Bochum. www.bergbaumuseum.de
 The staff was generous in guiding me through their fine collection of surveying instruments, and especially, plumb bobs.
 Thank you for the help.

From my own collection:
 HANGING COMPASS and GRADUATED ARC from the VEB FREIBERGER Präzisionsmechanik in a wooden box with a belt. (1950-1970)



Some of their collection of particular interest to the *plumb bob collector*:



SIGHTING DEVICE with graduated arc. (Origin DBM)
 In the book from LEUPOLD 1739 I found an excellent example of this instrument, with a plumb bob in the handle.



HANGING COMPASS and GRADUATED ARC
 measures angles in all directions.
 Origin:DBM Bochum





A reproduction of an ancient sighting instrument called **CHOROBAT** (with 2 plumb bobs) Origin: DBM

To MEASURE distance, a uniquely marked MEASURING CHAIN. Without light, the distinctive feel of the periodic markers allowed the surveyor to count the distance. (pictures not from DBM)

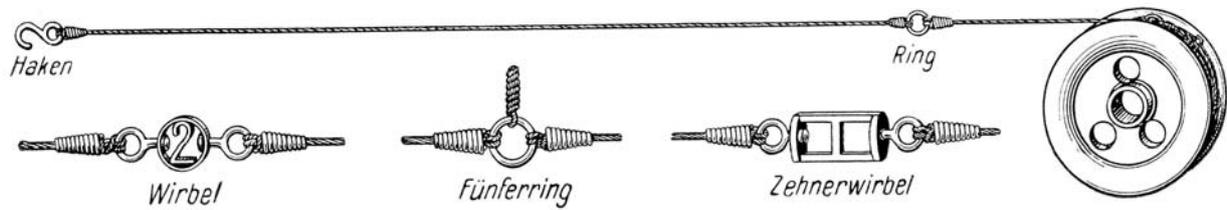
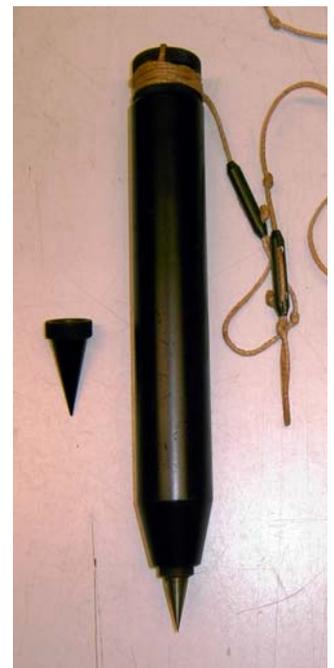


Abb. 15. Meßkette



THE COMMON PLUMB BOB, a centering plumb bob with a cap to protect the very sharp tip. This was hung under the tripod. (similar to the land surveyors). Attached in the plumb line: a device for the fine adjustment of the length of the plumb line. (Origin DBM)

4. PLUMB BOBS FROM DOMINIT

These plumb bobs were used in connection with a special holder and an electric mining lamp for specialized surveying work in darkness. **The top is formed to match with a sphere / globe.** As an accessory, I found a spring loaded tool to fine tune the length of the line.

See below: How this plumb bob works with the mining lamp, DOMINIT BOM.



DOMINIT PLUMB BOBS + ACCESSORY. Origin DBM





Photographic layout



5. DOMINIT MINING LAMP Type BOM

One of the reasons for my visit in the museum was the patented electrical mine surveyors lamp from DOMINIT type BOM "Dispositif pour l'indication d'un point de visée"

Patents:

- GERMANY DE441880 Dr. Köplitz in Börning / Herne 29. Juli 1927 "Vorrichtung zum Kenntlichmachen eines Zielpunktes" +
- FRANCE FR636076 31.März 1928 „Dispositif pour l'indication d'un point de visée“

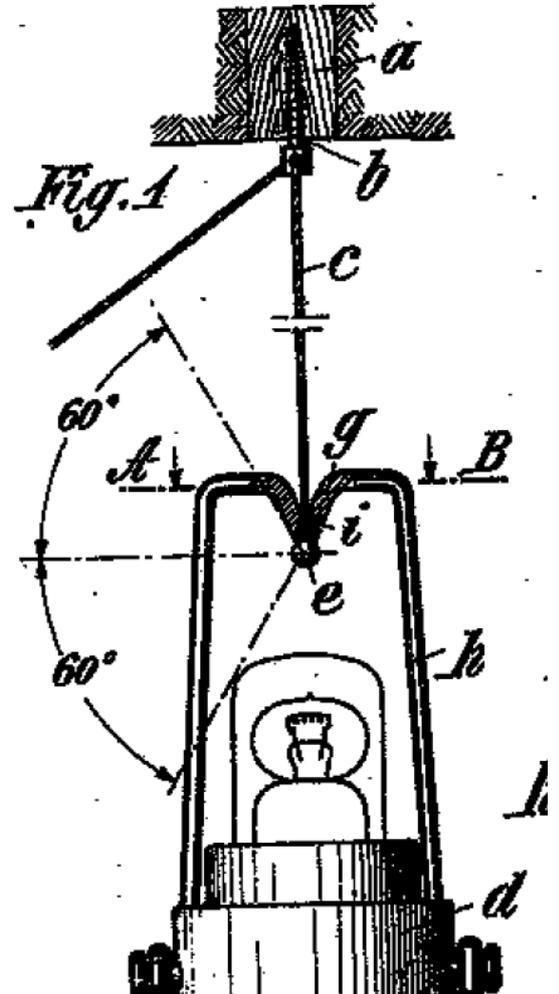
(Copy on demand).

Translated text from the patent (extract):

In the ceiling is fixed a piece of wood *a* with a hook *b*. A line *c* is led through the hook to hang it in any high. It is a braided line, not twisted cord, to avoid a turning of the lamp. The line ends in a ball *e*.

The lamp *d* wears a frame *g* consisting of two or more composed pieces *h*.

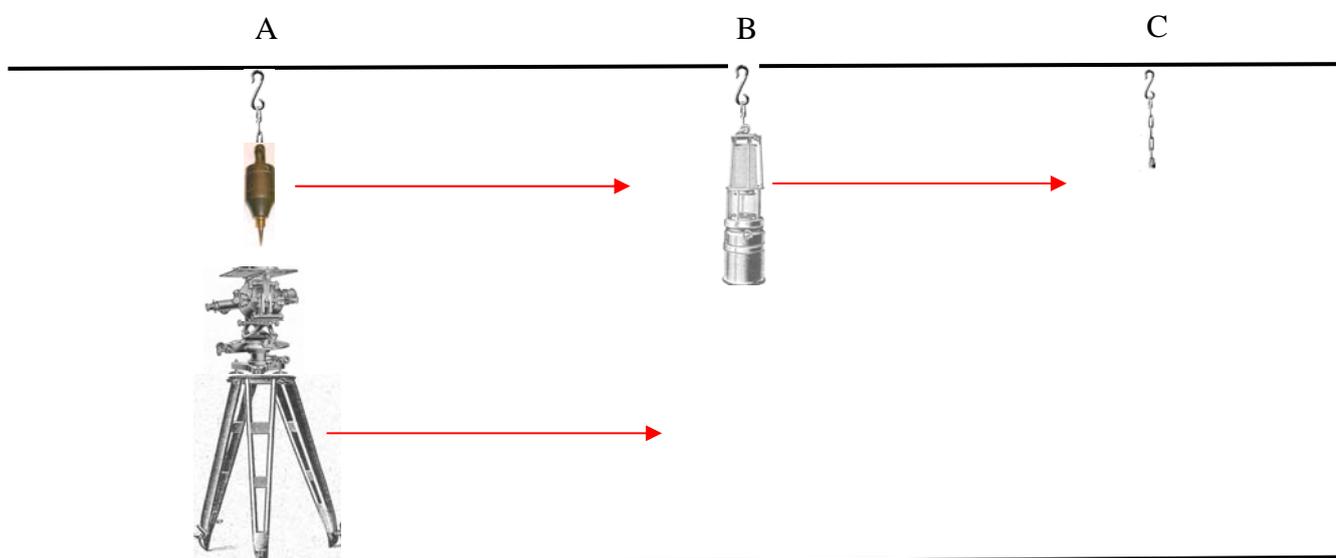
The head of this body is truncated and shaped to a pan in which the ball *e* matches. To mount the lamp easily the body is slit on one side. The light of the lamp *d* shines directly on the ball *e* and is reflected. So you can easily see the ball in the cross hairs of your leveling instrument. Also the line *c* is lighted and can also be used as a target.



INSTRUCTION for use of the PLUMB BOB, the BALL and the MINING LAMP is written in the Catalogue DOMINIT 1930 as follows: (EXTRACT):

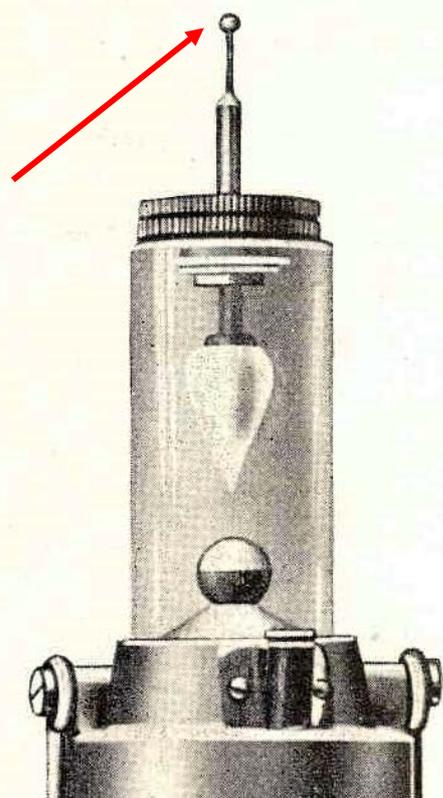
1. Hang LINE WITH BALL and PLUMB BOB in the HOOK at A
2. Bring the LEVELLING INSTRUMENT in correct position.
3. Hang MINING LAMP on the BALL at the line in B Align sight at B and note results.
4. Bring PLUMB BOB and LEVELLING INSTRUMENT from A to B
5. Took MINING LAMP from B and hang it at C on the ball.
6. Hang PLUMB BOB on the ball at B and bring the LEVELLING INSTRUMENT in correct position. Make the measurement. Etc.

SYSTEM DOMINIT with 1 plumb bob and 1 Mining lamp



WOLF'S MINING LAMP FACTORY:

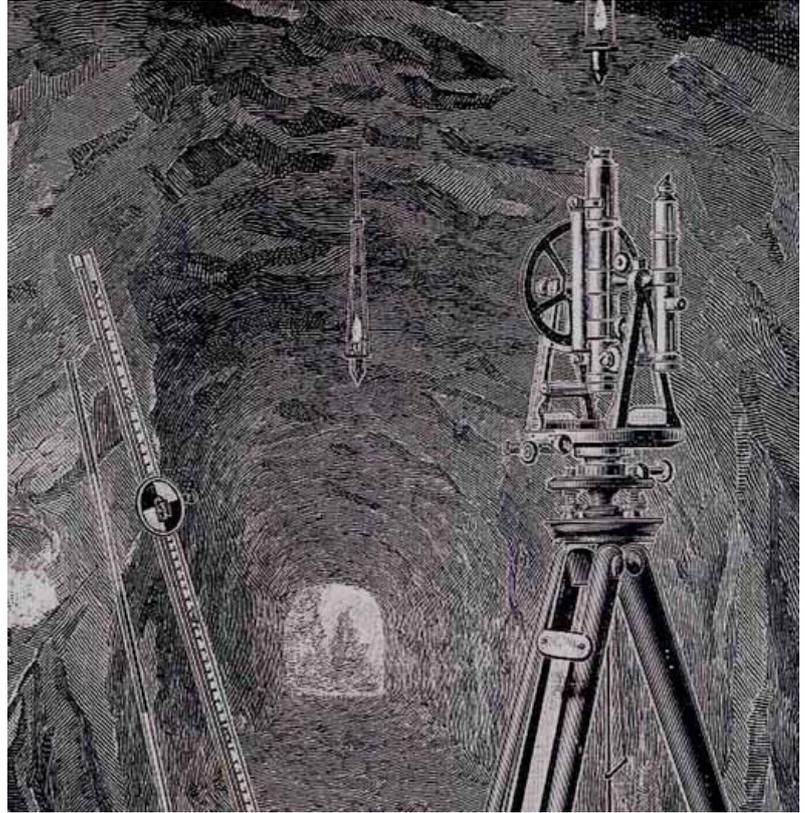
A copy of this catalogue page is my only evidence of this mining lamp. It seems similar to the DOMINIT lamp in many ways, with the exception of BALL at the top and not on the hanging line. Will search for more information. Am hoping this might be a lupine relative. ☺:



6. AMERICAN MINING PLUMMETS

The American Mining Plummet was used most frequently in pairs or threesomes, hanging targets for the surveyor's instrument. Self illuminating, the plumb bob body is hollow, doubling as a reservoir for lamp oil and woven fiber wick.

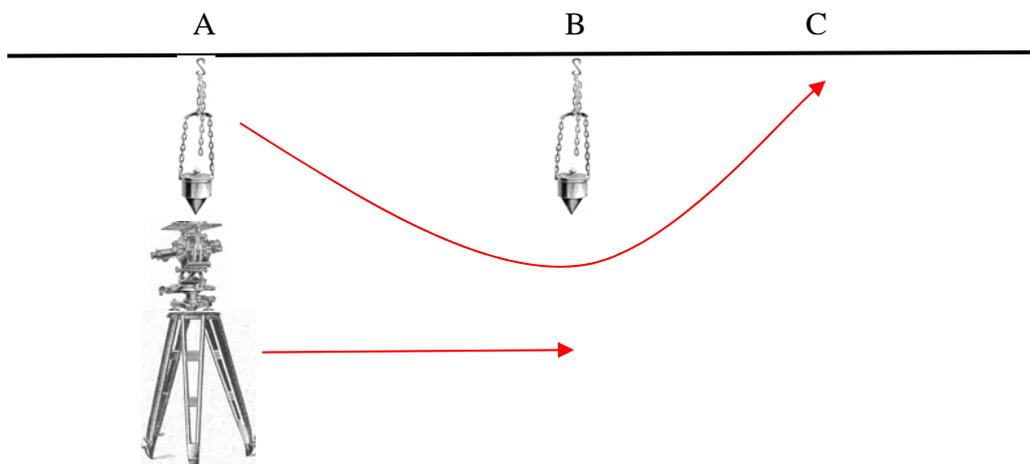
Hung frequently on a nail-like device with a hook called a "spad". The "spad" was driven into the stone ceiling or overhead wood shoring with a hammer. The plummet is suspended from it on a yoke, chains and gimble. This hanging assembly centers the flame atop the bob and the tip, directly beneath the "spad". When the survey is complete, the "spad" remains as a permanent mark recording the location of that particular point "station", on the underground map grid. Those more familiar with surface land survey work, the "spad" is like in function to the surveyors "monument," or "iron pin."



American plummets are characterized by their carrying containers, boxes with shoulder straps most often made of wood. Provided by most manufacturers as a necessary adjunct to the plummets themselves, they kept the plummets upright so as not to spill their lamp oil as the surveyor

carried them from point to point through the mining tunnels. The plummet when not in used can be a tangled lump of parts, especially difficult to manipulate when the only available light might have been the surveyor's head lamp. The fitted box, no doubt, kept the tools contained in a manageable way. When survey work was underway and a surveyors station was being set up, a box of plummets could be set on the mucky mine tunnel floor and offer a degree of protection to the plummets from the dampness and mud.

SYSTEM USA with 2 MINING PLUMMETS



Below some pictures of mining lamps from the collections of Nelson Denny, Dogan Basak, Riccardo Chetoni, my collection and others. Thank you.
 Also some drawings from catalogues and patents.



Collection Nelson Denny

UNNAMED PAIR OF
 MINING PLUMMETS
 IDENTICAL IN EVERY
 DETAIL TO THE "YOUNG
 AND SONS PAIR" WITH THE
 EXCEPTION OF THE
 MARKING ON THE YOLK



Collection Nelson Denny

BUFF



BUFF & BERGER



Collection Nelson Denny



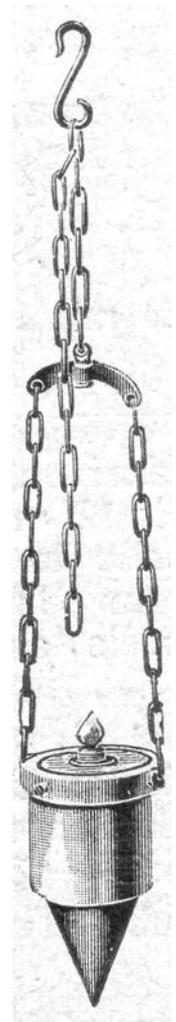
Collection Nelson Denny



Collection Nelson Denny



Left: Collection Wolfgang Ruecker
US pat 2538475 SKRASTIN 1948
LIGHT PLUMB BOB



Right:
offered in catalogue
REISS Liebenwerda
Germany c 1913.
Nr. 6077 MINING
LAMPS mount on
gimbals.
The chains can be rotated
to eliminate misalign of
the flame.
1 pair in a box 33Mk

WELSH graduations



Collection Nelson Denny

GURLEY single



Burning Mining Plummet.
Ears vertical; with gimbal

ENGLAND



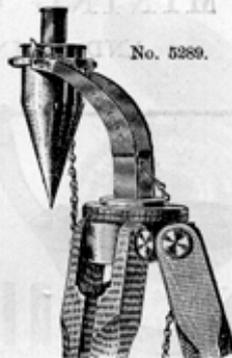
Coll. R. Chetoni

KEUFFEL & ESSER CO. NEW YORK.

MINING LAMP AND PLUMMET.



No. 5285.



No. 5289.

- 5285. One Plummet, about 6¼ in., in mahogany Box with strap, each \$ 10 00
- 5286. Two do. in one mahogany Box with strap pair 18 00
- 5288. Standard for suspending Plummet, on plain tripod like No. 5176, (page 397) each \$ 15 00
- 5289. Standard No. 5288 but on Extension Tripod like No. 5182, (page 398) " 21 00

FRENCH MINING PLUMMET



Collection Riccardo Chetoni.
Without gimbal. Ears horizontal. Iron chain.
No protection against dropping water.

England



U.S.A.



Collection Dogan Basak

G. R. McKAY.

LAMP.

APPLICATION FILED JAN. 27, 1917.

1,231,925.

Patented July 3, 1917.

Fig. 1.

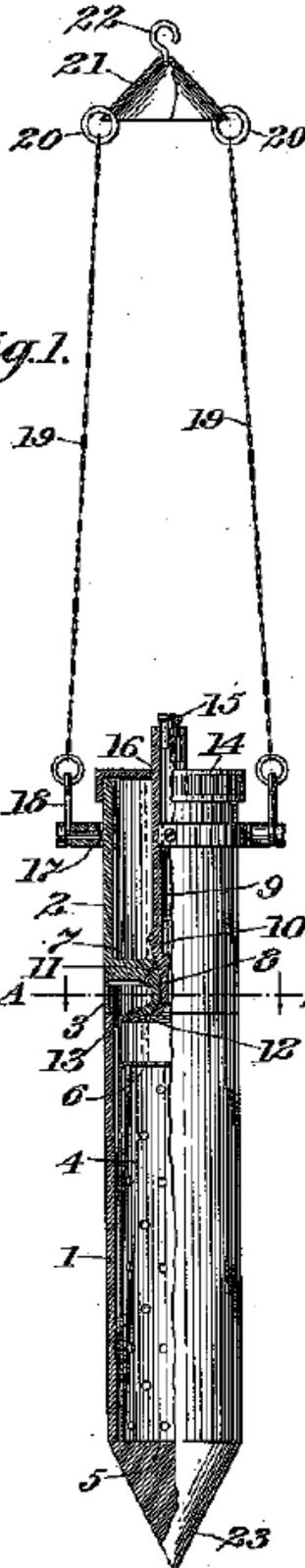


Fig. 2.

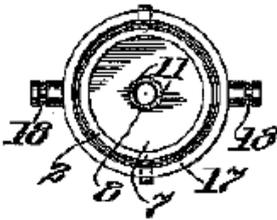
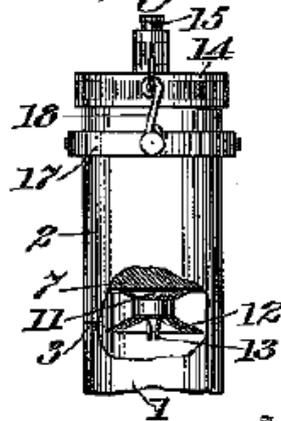


Fig. 3.



Fig. 4.



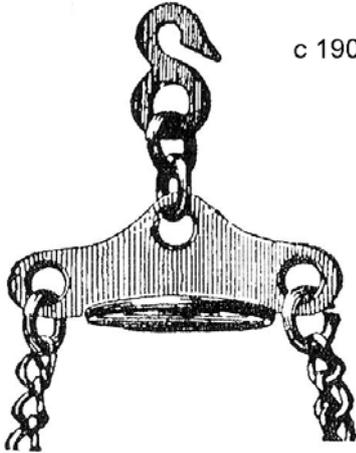
Inventor
G. R. McKay
by
W. H. Linnell
Attorney

Remark in the patent paper:
Some mining engineers carry their surveying points IN THE FLOOR instead of in the roof or timbers, and with a lamp of this character provided with the conical bottom it can be suspended accurately over the point.

1921

PLUMMET LAMP BUFF & BERGER

c 1900



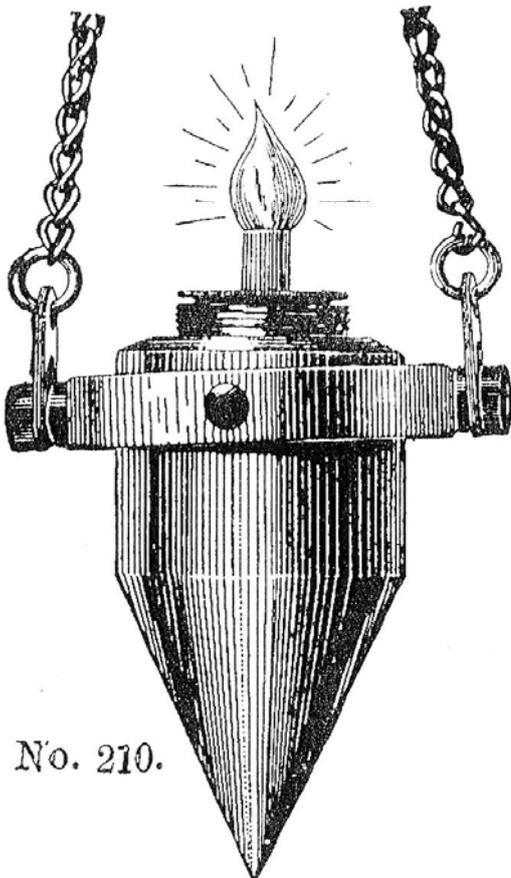
THE PLUMMET LAMP, No. 170, is a large plummet, of which the upper part is hollow to contain oil. It has a tube with a wick, and an extinguisher.

It is hung in gimbals by chains with a hook, and so always assumes a vertical position, and when suspended from the shifting center of a leveling head it can be easily adjusted over a given point.

These lamps are packed in a wooden case, furnished with a strap to sling over the shoulders. The weight of each lamp is about one and one-quarter pounds, and either one, two, or three may be packed in a single box.

FIG. 32

NO. 170 PLUMMET LAMP



No. 210.

Small plummet lamp 16 oz, brass, steel point



FIG. 12.

Gurley 1883

PLUMMET LAMP.

As shown in Fig. 12, this is a large plummet of which the upper part is hollow, to contain oil; and has also a tube for wick covered by a screw cap.

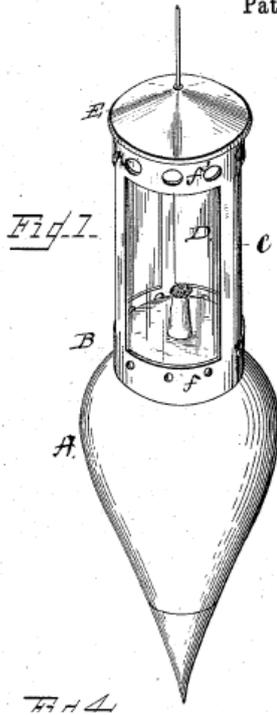
It is hung in gimbals by a chain with hook, and so always assumes a vertical position, and when suspended from a tripod with shifting centre, can be easily adjusted over a given point.

Two of these lamps are often packed in a simple wooden case, furnished with a strap to sling over the shoulders; the weight of each lamp is about one and a quarter pounds.

J. ROACH.
PLUMMET LAMP.

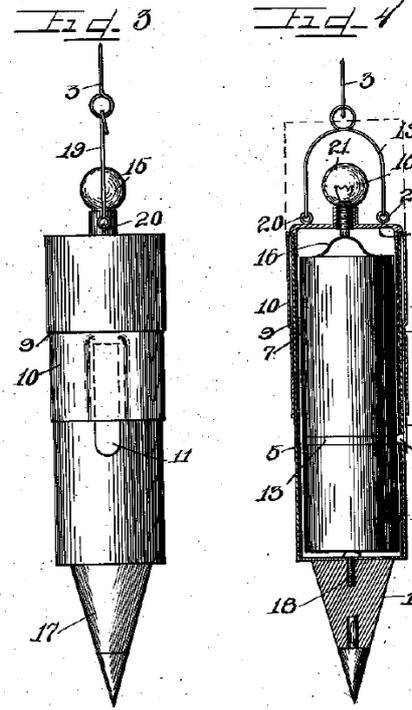
No. 287,580.

Patented Oct. 30, 1883.



1,113,519.

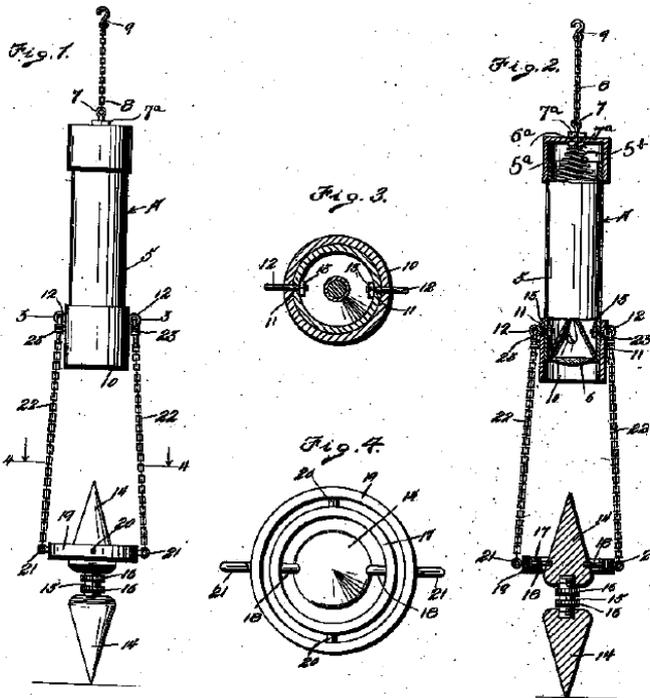
Patented Oct. 13, 1914.
2 SHEETS—SHEET 2.



O. V. MARTIN.
PLUMMET LAMP.
APPLICATION FILED MAY 1, 1912.

1,052,075.

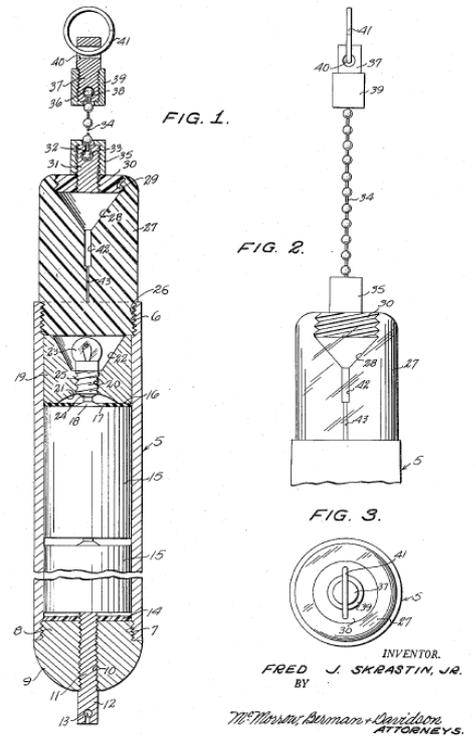
Patented Feb. 4, 1913.



Jan. 16, 1951

F. J. SKRASTIN, JR.
SURVEYOR'S ILLUMINATED BACKSIGHT
Filed Aug. 13, 1948

2,538,475



LINKS of interest:

<http://www.surveyhistory.org/> Virtual Museum of Surveying

<http://www.bergbaumuseum.de> DEUTSCHES BERGBAU-MUSEUM BOCHUM