A NEW TYPE OF IRON TRIGONOMETRICAL BEACON.

(Extract from an article by C. TROMBETTI in *L'Universo*, Florence, Aug. 1933, page 636).

REQUIREMENTS OF A TRIGONOMETRICAL BEACON.

A trigonometrical beacon should fulfil the following requirements :

1. Be solid, to resist the weather and inevitable rough treatment.
2. Provide a robust support for geodetic instruments.
3. Enable a station to be set up in the centre.
4. Fix securely the trigonometrical centre.
5. Be regular in shape to avoid errors of measurement.
6. Be of such a shape that it can be collimated with the hair lines of the telescope of the Universal.
7. Be of dimensions such as to make it visible from some 60 kms. (37 miles).
8. Be of a colour clearly visible at a distance.
9. Be oriented in such a way that a diagonal of the base (the conical form is barred on account of the difficulty of construction, in common beacons) should be in the direction of a meridian, in order that it should always be visible whichever face is illuminated.

DESCRIPTION.

The new first-order trigonometrical beacon under trial by the ISTITUTO GEOGRAFICO MILITARE is of iron, cast or welded, and can be dismantled or assembled easily on the spot. It consists (Figs. 1 and 2) of three prism-shaped sections of equilateral-triangle cross section, with sides of 350 $^{m}/_{m}$ (13.75 ins.) in height and a thickness of 6 $^{m}/_{m}$ (0.25 in.).

SEGNALE TRIGONOMETRICO IN FERRO

vista assometrica dei due modi di ancoraggio

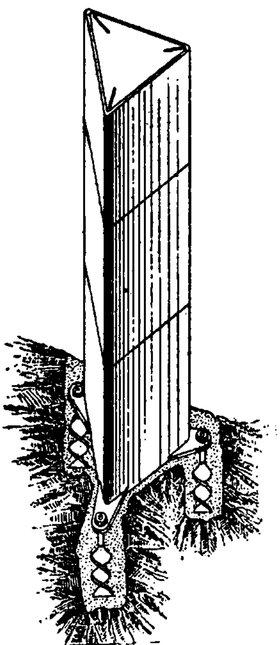

Fig. 1

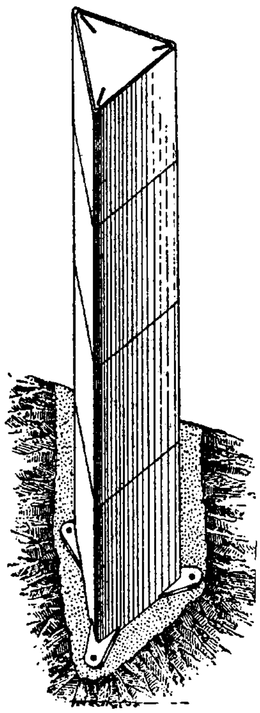

Fig. 1

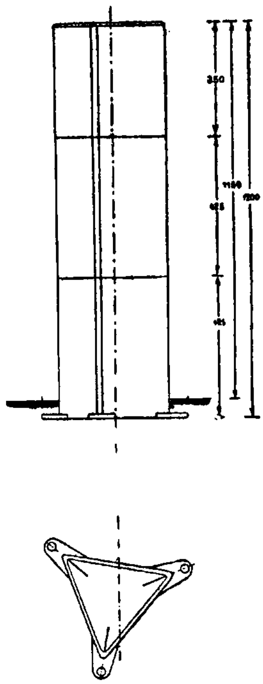

Fig. 2

The upper section (Fig. 3), closed at one end, is 350 m/m (13.75 ins.) in height and has at the bottom, inside and at the corners, three webs to which to attach the other sections. On its upper face, at the edges, there are three holes at 120° to take the levelling screws of the geodetic instrument.

The middle section (Fig. 4) is 425 m/m (16.75 ins.) in height and has the three webs both at top and bottom.

The lower section (Fig. 5) is 425 m/m (16.75 ins.) in height and has three webs at the top, while at the bottom it has three lugs with holes to take the anchoring screws.

The six screws for the assembling of the three sections are common screws with a diameter of 5 m/m (0.197 in.).

The three anchoring screws can be of the shape and dimensions indicated in Fig. 6, which are easily found in commercial use; they are 250 m/m (9.75 in.) long and have a socket at the bottom to enable one, where the ground may be rather soft, to screw another screw into the first one, so as to go down to 500 m/m (9.5 in.).

The cement, sand and water for the foundation of the screws and for burying the base of the beacon for 5 c/m (2 in.) are reckoned at 6, 13 and 3 kgs. (13.2, 28.6 and 6.6 lbs.) recpectively. The gravel is made with stones taken on the spot.

If the ground is easy to dig, instead of securing the beacon by means of the anchoring screws it can be done with four sections (Fig. 7) by joining another one similar to the middle one, and burying almost the whole of the bottom section underground by making a suitable hole and securing it with a filling of cement between the rock and the signal. The three lugs of the lower section will prevent the beacon being dislodged, while its triangular section will prevent its rotating. Naturally, a greater quantity of cement, sand and water will be required.

TRANSPORT.

The beacon with all its accessories is transported on the shoulders by means of a suitable equipment of shoulder-pieces (fitted with pads, straps and beckets) the porters being loaded as follows :

1. Upper section of the beacon, with case, weight 22 kgs. (48.4 lbs.).
2. Middle section of the beacon, with case, weight 22 kgs. (48.4 lbs.).
3. Lower section of the beacon, with case, weight 23 kgs. (50.6 lbs.).
4. Anchoring screws, 6 in number; attaching screws, 6 in number; picks for digging, 3 in number; shovels 3 in number; red lead, one box; spanner; case. Weight 23 kgs. (50.6 lbs.).
5. Cement, 6 kgs. (13.2 lbs.); sand, 13 kgs. (28.6 lbs.); water, 3 kgs. (6.6 lbs.); containers and case. Weight, 23 kgs. (50.6 lbs).

When it is thought that the ground will be easy to dig and that therefore it will be possible to bury part of the lower section, two more porters will be required, loaded as follows :

6. Loaded as No. 2.
7. Loaded as No. 5 (on account of the greater quantity of cement etc. required for the foundation).

The fourth porter, in this case, instead of the 6 anchoring screws can carry a pick-axe and three more joining screws.

ERECTION.

While three porters make the holes in the rock for the anchoring screws at the required distance (determined by the lugs of the lower section) or make the hole for burying the lower section, a fourth porter joins the elements together with the proper screws, starting by joining the upper to the middle element, and finally a fifth porter prepares the mixture.

The holes having been made, the trigonometrical centre fixed, and the anchoring screws fixed with cement, nuts are placed on the three screws, then the beacon is placed over them and finally the three other nuts are added. With a level placed on the top surface of the signal, it is set horizontal with the screws at the bottom lugs; the screws are tightened up and the projecting part of the bolts rivetted down.

A ring of cement is then banked up outside the signal to a height of 5 c/m (2 in.).

Things are easier when it is possible to bury the base of the signal; the hole is made, the signal is inserted therein and cement piled between it and the rock.

It is well to apply a coat of red lead to preserve the beacon from rust.

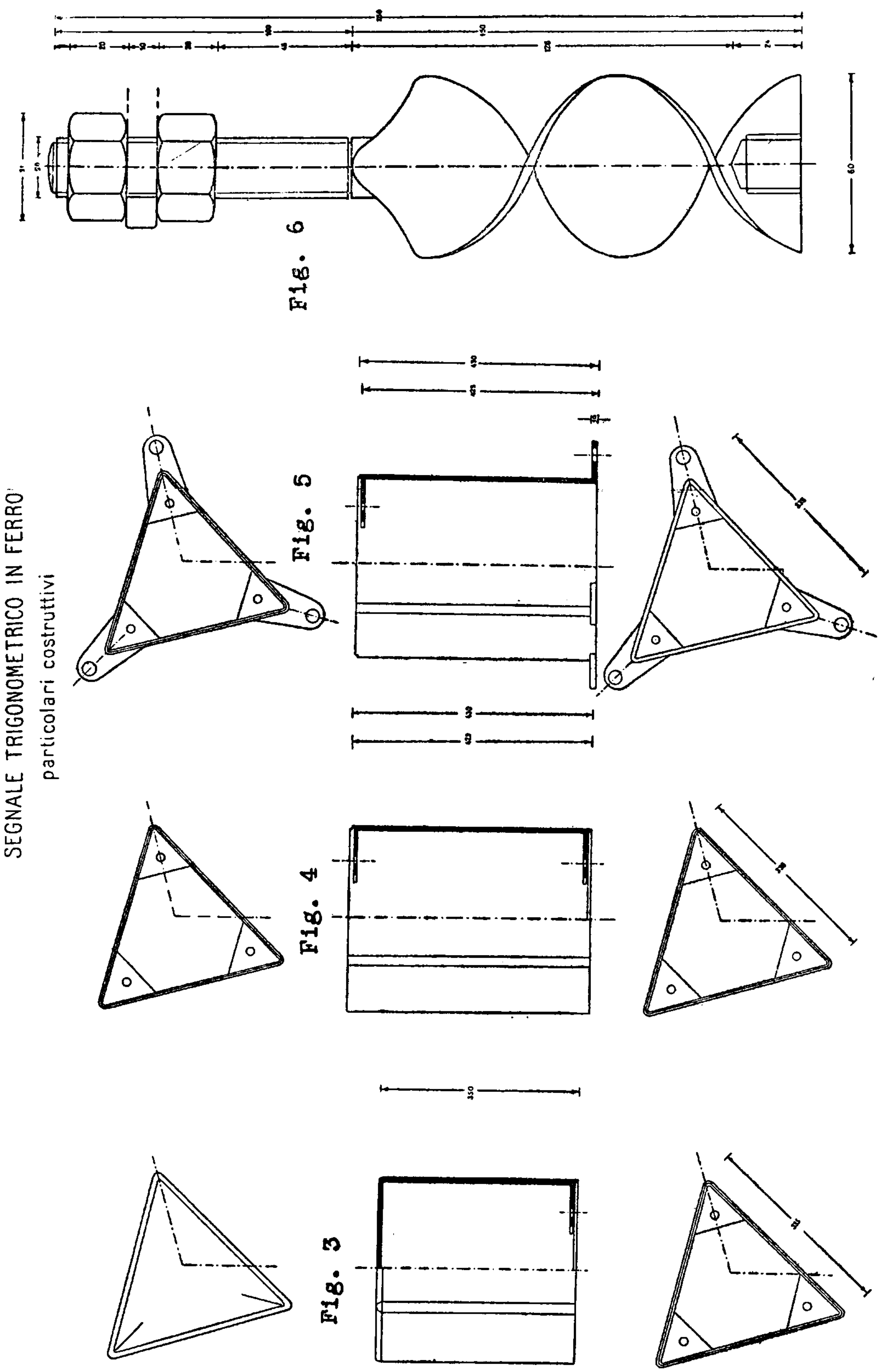
Fig. 6
SEGNALE TRIGONOMETRICO IN FERRO
particolari costruttivi
Fig. 5
Fig. 4
Fig. 3

TIME TAKEN TO ASSEMBLE.

The time required for assembling is principally taken up by the digging. We have found from experience that under the worst conditions for making the three holes and the triangular excavation, a maximum of 5 ½ hours' time is required. For the incidental work and the filling with cement another half hour is required.

Altogether, then, six hours' work is needed.

REQUIREMENTS AND ADVANTAGES.

This newly constructed beacon satisfies in principle the first four requirements mentioned; if a pyramid with a triangular base is built up dry upon it, with material obtained on the spot, having a diagonal in the direction of a meridian, a height 1/8,000 of the greatest distance from which it must be sighted, and a width of base equal to two thirds of its height (on a bare and isolated peak these proportions may be reduced by a quarter or even more) it will satisfy the other five conditions.

Apart from the ease of transport of an iron and very robust beacon of this type, the proposed thickness of iron of 6 m/m (0.24 in.) makes the beacon resistant to any damage from weather, and being held together by internal bolts, it cannot be dismantled without first uprooting the whole beacon.

It might be felt that the beacon could be damaged, if not destroyed, by lightning: in this respect it may be observed that there are already two examples of iron beacons constructed in 1879 on Mte. Guglielmo, 1949 m. (6,394 ft.), and Mte. Arera, 2512 m. (8,241 ft.), using a small cylindrical pillar of pig iron surrounded by a pyramid of dry material. The beacon on Mte. Arera has been destroyed by causes other than lightning, while that on Mte. Guglielmo is still in existence.