crete: the large stones are not so apt to separate from the finer gravel as when it is shot in a continuous stream out of a trough.

In general practice it is considered sufficient to have the materials turned over twice, and then to apply water through the rose of a watering-can, turning over the materials three different times in the process of wetting. Some engineers demand that for wetting the concrete only the smallest quantity that will suffice for wetting shall be used, but there can be no doubt that an excess of water is beneficial rather than injurious to the concrete, for in getting concrete into position much water passes away by absorption, by evaporation, or by actual leakage, so that in many instances the concrete is left too dry to allow of its setting perfectly. When concrete is made thoroughly wet it can bear to part with some of the surplus water by absorption, etc.; all the rest rises to the surface without bringing with it any portion of the cement. When put in wet the concrete admits of being rammed thoroughly solid against the sides or framing, while the matrix never fills in the interstices in the aggregate so thoroughly as when water is freely used in mixing. No cement sets better than such as is covered by the tide almost immediately after it is put in place. It is needless to say that in frosty weather excess of water in mixing concrete is to be avoided.

The shingle used at Chatham is dredged from the bed of the River Medway; it contains a certain amount of loam. When the quantity of loam is small, twelve parts of the shingle to one part of cement makes not only a good hard, but a very tough concrete; but an excess of loam is injurious, and as the workmen say, "kills" the cement. In winter the slightest excess of loam in the gravel renders the concrete liable to injury from frost for a long time after it is made. Sand, if too fine, although it may be sharp and clean, is often little better than dust and acts in the same way as loam.

The most convenient size for a depositing box for placing concrete below water, is one with a capacity of about sixteen cubic feet. In Blyth harbor, where large quay walls were built in 1884, it was found that the cost per cubic yard, for concrete, was as follows:—

ABOVE LOW WATER LEVEL.—PROPORTIONS 7 TO 1.

	s.	d.
Cement, 4 0 cubic feet, = 0.16 ton	5	9
Stone and sand	2	3
Breaking stone and incidental expenses	1	2
Mixing and wheeling	2	4
Planking	1	0
Per cubic yard	12	6

BELOW LOW WATER LEVEL—PROPORTION 6 TO 1.

	s.	d.
Cement, 4.5 cubic ft. 0 18 ton	6	6
Stone and sand	2	3
Breaking stone and incidental expenses	1	2
Mixing and wheeling	2	4
Planking (fixed by diver)	4	0
Depositing by crane	0	9
Dive depositing in place	2	0
	19	0

Below is the cost of a cubic yard of concrete at Chatham, formed of 12 parts of shingle to 1 part of Portland cement, calculated carefully in detail at ordinary rates for material and labor:—

	s.	d.
1 1-5 cubic yard gravel (including 16 per cent. for shrinkage and 4 per cent. for waste), per cubic yard, 2s.	2	5
2 1-16 cwt. Portland cement (including allowance for waste and use of bags), per cwt., 1s. 6.	3	1
50 gallons water (including allowance for wasteband use of service-pipe), per 1,000 gallons, 10d.	0	0½
1 cubic yard mixing concrete and depositing in work, per cubic yard, 1s. 1d.	1	1
1 1-5 cubic yard wheeling gravel (including use of crane and depositing in trucks), per cubic yard, 3d.	0	3½
2 1-16 wheeling cement, placing in store, loading at store, unloading at work and use of store shed, per cwt., 3s. 4	0	1½
1½ cubic yard transport of concrete to work (including use of trucks, roads, banking, etc.), per cubic yard, 1d.	0	1½
	7	2

The cost so estimated of 1 cubic yard of concrete is 7s. 2d. Calculated on the same basis a yard of 9 parts of shingle to 1 part of cement will cost 8s. 2½d., and of 6 parts of shingle to 1 part of cement 10s. 3d. A cubic yard of slag concrete (6 to 1) used in facing costs about 12s. 2d. per yard; if flint face concrete about 14s. 2d. The proportions of slag concrete, at 12s. 2d. required for facing is so small that the whole cost of the concrete on a lineal foot of wall is only increased about 2½d. per cubic yard, making the entire cost of the wall, including staging and framing, about 7s. 10d. per cubic yard.

(Concluded in next issue).

FACTS ABOUT BOILERS.

ARTICLE No. 3.

THE AGGREGATION OF PIPE AND FITTINGS.

This stage of boiler making occupies the same plane in boiler development that the rotary engine does in its field. Most everybody has been touched by the disease. The materials are all at hand, and the details can be mostly bought ready made. By the addition of another elbow, coupling or return bend, the budding genius of a boiler inventor sees the heights of fame and dollars within his reach.

It would be more charitable to simply place *Punch's* remark, "Don't," under a picture of these seductive pieces. But facts will out, and a few "horrible examples" will suffice to illustrate.

As a rule it can be said that the later the date of the attempt the worse the results. They are all based on the following recipe:

First. Crowd in the greatest possible amount of heating surface, no matter how or at what sacrifice of other equally necessary requirements.

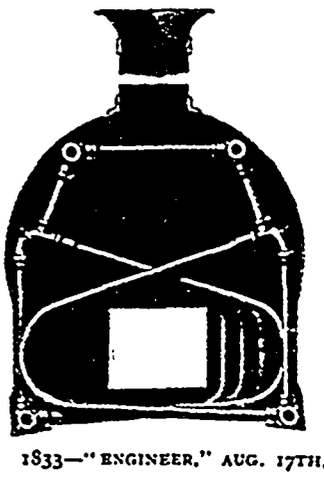
Second. The more bends and right angles so placed as to obstruct circulation the better.

Third. On the same basis that a steam engine will run more regularly without than with a fly wheel, cut down the steam and water capacity to the lowest possible limit.

Fourth. Make it as far as possible out of pipes and fittings screwed together, and place the fittings and joints in the hottest position.

Fifth. Firmly take the position that it will never need repairs, and render them difficult to make.

Sixth. Assert that it will never need internal cleaning, and avoid all facilities for so doing.



NO. 35. 1833—"ENGINEER," AUG. 17TH, 1894.

Seventh. No matter how closely it copies some other discredited aggregation, give it a new name and it will go for a while.

SIR CHAS. W. DANCE, the inventor of a steam road carriage in England, joined Joshua Field (of Maudsley & Field, the builders) in patenting the first boiler of this description, and can be