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affected by the same atmospheric influences; and that, consequently, they rarely concur in producing the same flood. In 1866 as in 1856, the inundation was due almost exclusively to the great feeders, the Cher only amongst the minor tributaries exercised any sensible influence on the inundation.

The idea of protecting the valleys against the invasion of water is of old origin; the construction of the dams of the Loire are of very ancient date, and have been objects of the care of every sovereign and of all the governments that have existed in France.

It is incontestable, however, that these dams were ill-conceived in principle as well as imperfectly executed; that some of them were unnecessary; and that they are dangerous in cases of great floods, which surmount and break them down. But we must not at once conclude that they are more hurtful than useful to the valleys, and should be forthwith destroyed or diminished in height. In the present state of things the greater portion of the floods pass without producing any injury. That of 1825, for instance, which was very considerable, did no damage, yet the bed of the river was filled to the very top of the dams, and if they had been less elevated the waters would have produced the same disasters as occurred in 1846, 1856, and 1866.

One of the principal causes of the mischief produced by those inundations has arisen from the too great confidence felt by the population of the valleys in some of these dams, which remained uninjured from 1790 to 1846, during which time town and villages grew up in their neighbourhood, while the periodic return of extraordinary floods since that date is a terrible warning for all the world.

The actual quantity of water that may be contained within the embankments of the Loire tells us that the volume may be equal to 6,000 or 6,500 cubic metres per second; but the maximum flow of the Loire at the point where the Allier falls into the former rose in 1856 to upwards of 9,000 metres: consequently the dams below this point were broken down. In consequence of this rupture a portion of the water ran off into the valleys, and the maximum never reached beyond 6,400 metres per second at Tours; but below Tours, the Cher, Indre, and Vienne again swelled the flood to an extent greater than the capacity of the bed of the Loire.

It is then evident, therefore, that the raising of the height of the dams would not prevent the inundation of the valleys, and would in fact only increase the danger.

It remains therefore to examine whether, instead of opposing new obstacles to the stream, it is possible so far to diminish the height of the floods as to bring the volume of water within the capacity of the bed of the river.

In a report by the inspector-general Comoy, who has charge of the basin of the Loire, recommends the establishment in the upper part of the valley of this river thirty-three reservoirs, which should contain together 234,000,000 cubic metres of water, and thirty-five others in the valley of the Allier with a total contents of 286,000,000 metres. The retention by such means of 520,000,000 cubic metres of water would have the effect of reducing the total flow of the two rivers below Bec d'Allier to 6,050 metres, and consequently the river, which down to Tours receives no important tributaries, would in that part of its course be retained within its embankments.

Below Tours the establishment of reservoirs would cause more evil than good, for the rivers there reach their maximum height before those above, and consequently it is better to let their waters run off at once than to store them up in reservoirs. Below Tours, then, the only thing to be done is to increase the height of the dams. The cost of these works is estimated at 78,000,000f. (£3,120,000) but at the same time that these costly works are undertaken for the protection of embanked valleys it would be necessary also to repair the submergible parts of the valleys by making good the injury done by the flood to the banks, and by establishing submergible dams in various places. The total cost of these works for the entire course of the Loire to Nantes, for the valleys of the Allier, the Cher, the Indre, and the Vienne, is estimated at 22,000,000f.; so that the grand total for the basin of the Loire amounts to four millions sterling.

This system of reservoirs (says the minister) meets at once the problem proposed by the Emperor and corresponds with the lessons of experience, but M. Comoy's proposal, it is said, still requires further studying; the author took for his basis the inundation of 1856, but as that of the present year surpassed the former at several points, it is evident that the calculations were based on insufficient data. The report goes on to say that as soon the necessary corrections have been made the authorities will proceed to carry out the work with all possible dispatch.

Unfortunately this report and assurance closely resemble those made in 1856; at that time reservoirs were declared to be the only possible resource against the flooding of the upper part of the basin of the Loire, and at that time also the work was ordered to be carried out with the greatest possible dispatch; ten years have elapsed since then, and yet the Loire has no outlet for its superfluous waters. The expenditure of four millions in such a work, extended over a few years, is a mere trifle, but such calamities as have occurred in 1856 and 1866, to say nothing of one or more smaller inundations in the intervening period, each entailing not only damage to the amount of something like a million to public works, but destruction of private property to the extent of perhaps more than six times that amount, are too terrible to excuse hesitation or delay.

The measure of the mischief is sadly indicated in the fact that while the individual losses in 1856 are stated at 177,000,000f., the subscriptions collected in aid of the sufferers from this year's inundation, amounting probably to little less, have not yet reached 2,000,000f., and that in spite of extraordinary exertions all over the country. The first instalment, amounting to 280,000f., was placed in the hands of the prefects last week to be distributed amongst the most necessitous of the sufferers.

ROCKET APPARATUS, FOR SAVING LIFE FROM SHIPWRECK.

By Thomas Gray, Esq., H.M.C.S.

Having given in The Engineer of July 6th (No. 549) a short account of the nature and description of the projectiles for saving life from shipwreck, we will now turn our attention to the lines carried by them, and to the manner in which those lines are coiled, stowed, or faked to run out with the greatest ease after the shot or rocket.

Before, however, going into the subject of the gear it may not be out of place to remark that the rocket, a missile once known as the most erratic in military services, has become one of the most reliable in saving life from shipwreck. It is altogether a rare occurrence for the coast guard with the rockets to miss a ship in distress if she is but within range; rockets have also in actual use proved, on the whole, to be very safe and manageable. Although several thousands have been used they have never yet (that is to say, since 1854, when the Government took up the subject) caused the slightest injury to any person on board a ship in distress, or to any person using them at a wreck. On two occasions at exercise, when rockets have got loose from the sticks and lines, they have done damage. In the one case a rocket, which was fired too low, went out about fifty yards to sea, when the stick was struck by the crest of a wave and parted, and the rocket returned to the shore. It went inland and through the roof of a cottage, where an old dame was in bed. It frightened her and broke some of her plates and cups, but did no other damage. The other case was more serious. It arose out of an experimental exercise with Dennett's coupled rockets (Fig. 8)*, and it showed the danger of using two rockets at once. In the coupled rockets two rockets are fastened side by side by means of iron coupling bands; and in the case referred to, one of the rockets only ignited at first, the bands then gave way, and a rocket got loose and struck the legs of an officer of coast-guard who was standing at some distance from the apparatus.

And now with regard to the lines and gear suggested by the various inventors and used at the present moment by the Board of Trade and coast-guard.

Sergeant Bell with his 8in. shot used a thick line, his object being to send a shot from the ship to the shore, with a line sufficiently strong for the crew to haul themselves ashore by.

Trengrouse, on the other hand, used a line neither thicker nor stronger than a mackerel line, and he coiled it in hollow balls, similar to the hollow balls of string one buys at the present day at a string shop. He attached to his rocket stick the end of the string that comes from the inside of the ball, and he found that it ran out freely, and generally without kinking or breaking, but then his rockets (8oz.) were very small.

Monsieur Delvigne adopted successfully a plan somewhat similar with his arrows (see Fig. 12), but failed when he tried coils with his shot. With small lines and low velocities this arrangement answers very well, and it possesses the great advantage of affording a close mode of packing, and an easy means of transit.

Some persons suggested that the shot lines should be carried in coils in tubs, but in practice it was found that they would not run out free of kinks. Others again have suggested that the lines should be coiled on reels, but in practice it is found either that the line so coiled breaks, or that the reel is capsized and follows the shot. For extended ranges we require heavier shot, stronger rockets, and higher charges of powder, and with them stronger, and therefore thicker and heavier lines. Large lines can never be used with success if fired from a ball, a reel, or a coil.

Knowing this, Sergeant Bell arranged his lines in layers of short "fakes" as he had formerly done with the line carried by his gun harpoon, invented for the northern whale fishery. Manby adopted the same plan, and he fitted a large basket with faking pins, in which he kept the lines ready for use; or when a basket was not or could not be provided, the line was arranged in short fakes side by side on the beach before firing, as shown in Fig. 14.

Horatio Dennett, when a youth, designed for his father, John Dennett, the best method yet hit upon for stowing the rocket line both for transport and for use. This appears to be one of Dennett's greatest improvements in the apparatus. He prepared a small oblong box having in it a loose frame fitted with spikes or pins, as shown in Figs. 15 and 16, and on these pins he faked his line in successive layers, as shown in Fig. 17.

When the line is to be used the frame with the pins is drawn out of the chest bodily, and the line is left in the chest without kinks in a series of layers of diagonal fakes. By this arrangement the line can be carried out slice by slice, or layer by layer, from the box with the greatest regularity, and without causing any "wabbling" in the shot or rocket.

It is very interesting to watch the line leaving the box and hear the gentle whizzing noise that it makes as streak by streak of each layer is carried out. The line does not form a direct curve between rocket and box while it is being carried out, but flies up about 10ft. from the box in the form of a parabolic curve, then bends down again to within a foot of the ground, and then flies after the shot or rocket, as shown in Fig. 18.

By Dennett's method of faking and stowing the lines they can always be kept on their pins in the boxes, and can be carried any distance. By withdrawing the pin they are ready for use at a moment's notice. This is the plan at present adopted for all rocket and shot lines in use on our coasts. When a rocket line has been used once and the line is wanted again immediately, it is faked down on the beach as proposed by Manby (Fig. 14).

The success of the apparatus much depends on the rocket or shot line. To get a strong, thin, elastic line is, therefore, of the greatest importance. Deep-sea lines used by Manby frequently parted; they were found to be laid up too hard, and were too stiff for the purpose.

John Dennett was the first to adopt the plan of laying up the rocket line very loosely, and he used New Zealand hemp, which is very elastic; it has, however, been set aside in favour of a stronger and more enduring material. Manilla hemp has been tried, but although its lightness is in its favour it is too hard and stubborn when wet to be of use. Silk was tried by Delvigne, but his silk line was not so strong as some hempen lines, and the material is very expensive.

After trying various materials, such as common hemp, silk, Polish Rhine hemp, Manilla, New Zealand, and several others, the material selected is Italian hemp. A rocket line of this hemp 500 yards long weighs 46 lb. This line is very enduring, and when laid up lightly is elastic. In Dennett's arrangement the line is attached by passing it through a hole in the tail of the stick and fastening it by a loop to the head of the stick. In Boxer's arrangement the line is passed through the tail of the stick, as in Dennett's, and is then passed through the head of the stick in the same way, when a knot is tied, and three washers of india-rubber take any jerk that may arise in starting the rocket.

At one time it was common for the rocket to carry away (*i.e.* break) the line, but latterly the writer has seen as many as thirty rockets fired without the line parting more than once, and then only through catching on a gun-carriage.

The rocket line being thrown over the ship the crew make a signal by waving anything in the day time, or showing any sort of light at night, to let those on shore know that they have got hold of it on the ship. The people on shore then "bend" on ("tie" on) to the rocket line an endless whip, fitted with a tailed block. When this is "bent on" a signal is made on shore, and the wrecked crew haul on the rocket line until they get the tail block on board. The "tailed block" is an ordinary 8in. block with a long tail fitted to it. This tail is to be fastened round the mast, or if the masts are gone to the highest part of the wreck.

The "whip" is a rope 240 fathoms long, with the ends joined together, working over the sheave of the tailed block, like an ordinary jack-towel on the back of our kitchen doors. It is clear that anything "bent on" (fastened) to this whip can be hauled backwards and forwards at pleasure to and from the ship by those on shore.

The "whip" and the "tail block" were invented by Manby, and are now the same as when used by him with the exception of a swivel, suggested by the author of this paper, as they are shown in Fig. 19.

Having got the tail of the block fast, and having now got a manageable communication between the wreck and the shore, the people on the wreck again make a signal, and the people on shore "bend" a hawser on to the whip and haul it off. This hawser is made fast on board above the tailed block, and a signal is again made on the ship as before. The hawser is then pulled tight from the shore to the ship by men holding on to it, or if there are not sufficient men to hold it taut, then a double block tackle purchase is used. If the soil is stiff or rocky, an anchor carried with the apparatus for the purpose, is placed in position, and one of the blocks of the purchase is made fast to the ring of the anchor, and the tail of the other to the end of the hawser, which is brought over a triangle to raise it from the ground. If the soil is sandy or loose the anchor is not used with the double block tackle purchase, but a piece of thick plank, about 4ft. long and 10in. wide, with a chain round it, is buried 3ft. or 4ft. in the soil. The end of the chain is led to the surface and is provided with a ring, to which one of the blocks of the tackle purchase is made fast as to the ring of the anchor.

It will now be seen that there is communication with the ship both by means of a movable endless whip and by a hawser stretched taut above it. The next thing is to send along the hawser what is commonly called a "chair." The name is borrowed from what is known on board ship as a Bosn's chair. But to a landsman a Bosn's chair is little better than a perch. The writer believes that Trengrouse first proposed to use a chair with the rocket apparatus. His chair was like the seat of a child's swing, and was a perfect luxury compared with a Bosn's perch. The writer recollects seeing Miss Swanborough landed safely from a wreck on to the stage of one of our favourite theatres, in a fine, good specimen of an old Windsor arm-chair. This was in Mr. Wilkie Collins's drama of the "Lighthouse." But the "chair" now used with the rocket apparatus is very different both from Trengrouse's and Miss Swanborough's, and is known as the "petticoat breeches."

These "petticoat breeches" were invented by Lieutenant Kisbee, R.N. They consist of a circular cork life-buoy, fitted with a pair of canvas inexpressibles, very large under the arms, and very short in the legs, in fact, legless, as shown in Figs. 20 and 21.

Perhaps it is, on the whole, as well that Mr. Wilkie Collins's interpreter availed himself of a poetical license, but for safety the "breeches" are preferable. The only discomfort the writer has felt in being hauled along in them arises from the jerks occasioned by the swing of the hawser. The "petticoat breeches" are suspended from an inverted block or traveller (Fig. 20), and are hauled backwards and forwards along the hawser by the endless whip. This is done by the people on shore. The person being saved sits with his legs through the "breeches" and with the buoy under his armpits, (see Fig. 21). He thus has the free use both of his arms and legs in cases of emergency.

The reader will doubtless think that to arrange and fire the rocket, to haul off the whip, and secure the tailed block—to haul off and secure the hawser, and then to haul the people one by one along the hawser—seems a long process by which to save a shipwrecked crew: but when the coastguard and volunteers are proficient in the use of the apparatus, cases are known in which a crew of fifteen persons has been saved in six minutes after firing the first rocket.

There is also an arrangement by which, when a ship is fast breaking up, or is on a very flat shore, the whip is made to serve the purpose of both hawser and whip, and the setting up of the hawser is saved altogether, as shown in Fig. 22.

During the last ten years this rocket apparatus alone has saved no less than 3,072 lives. This result is the best proof of its efficiency.

Having landed the last person from the wreck, the next thing to be done is to recover the hawser and whip line, for as they may be and often are required at another wreck the next moment, they must be got ready as soon as possible.

To recover the hawser a hawser cutter is used. The first suggestion for a hawser cutter was made by James Pengelley, a commissioned boatman at Penzance. It was a box fitted with a plane iron, working on a pivot and pressed upwards by a spring. An improvement has been made on this hawser cutter by the writer of this paper. The principle of Pengelley's cutter is retained, but the defects in it are overcome. A spring is bad wherever it can be done without; it is likely to spoil with rust and damp and to fail in frosty weather. If the spring in Pengelley's arrangement failed, the cutter was at once useless. In the second place, the iron cutter in that arrangement was always pressing on the hawser, and when the hawser was covered with sand and mud this iron would become rough, and would in its turn roughen, chafe, and spoil the hawser; and in Pengelley's arrangement there were no means of letting out the sand and mud that worked in. The action of the cutters will be understood on reference to the diagrams.

The first diagram, Fig. 23, shows Pengelley's cutter being hauled off, and Fig. 24 shows how the cutter acts. The remaining diagrams show the arrangement and action of the improved cutter.

A very ingenious cutter, and one likely to prove very successful, has also been invented by the Rev. Herbert Hicks, M.A. Mr. Hicks is an indefatigable member of the Tynemouth Volunteer Life Brigade (of which notice will be taken in a subsequent paper), and his cutter is by many thought to be superior to the other two.

When the cutter is to be used the "breeches" buoy is taken off the hawser, and the box containing the cutter is slipped on the hawser in its place. So long as the box is pulled forwards the cutter does not act. When the box gets close to the tailed block it is hauled backwards with a jerk. The spring in Pengelley's arrangement, or the lever under the iron in the improved cutter, or a simple lanyard in Mr. Hicks's cutter, then presses the iron against the hawser, which is severed close to the mast. The cutter is hauled ashore, and the whip is unrove, so that all that need be lost each time is the tailed block and a few feet of the hawser left on the mast.

Having safely used the apparatus, having landed the crew, and having got back the gear, we will in another number look into the organisations for using the apparatus on the coasts, and the results obtained.

T. G.

* The figures follow consecutively those given in our previous article.

Japanese Alloys.—The following notes relating to the composition of some of the many alloys in use among the Japanese are based on information obtained from native metal-workers. In a few instances, as with the *shakdo* and *gin shi bu ichi*, the process of manufacture, generally hidden, was shown me:—1. *Shakdo*, an interesting alloy of copper and gold, the latter metal in proportions varying between 1 per cent. and 10 per cent. Objects made from this composition, after being polished, are boiled in a solution of sulphate of copper, alum, and verdigris, by which they receive a beautiful bluish-black colour. I can explain this colour only by supposing that the superficial removal of the copper exposes a thin film of gold, and that the blue colour produced is in some manner due to the action of light on this film of gold. The intensity of the colour, and, to a certain extent, the colour itself, are proportionate to the amount of gold, 1 or 2 per cent. of this metal producing only a rich bronze colour. Pure copper treated in the above solution received the appearance of an enamelled surface with a rich reddish tint, and brass a similar surface with a darker shade. *Shakdo* is used for a great variety of ornaments, such as sword-guards, pipes, clasps, &c. 2. *Gin shi bu ichi* ("quarter silver") is an alloy of copper and silver, in which the amount of silver varies between 30 and 50 per cent. Ornamental objects made from this composition take, when subjected to the action of the above solution, a rich grey colour, much liked by the Japanese. It is used for sword ornaments, pipes, and a great variety of objects. 3. *Mokume*, several alloys and metals of different colours associated in such a manner as to produce an ornamental effect. Beautiful damask work is produced by soldering together, one over the other, in alternate order, thirty or forty sheets of gold, *shakdo*, silver, rose copper, and *gin shi bu ichi*, and then cutting deep into the thick plate thus formed with conical reamers, to produce concentric circles, and making troughs of triangular section to produce parallel, straight, or contorted lines. The plate is then hammered out till the holes disappear, manufactured into the desired shape, scoured with ashes, polished, and boiled in the solution already mentioned. The boiling brings out the colours of the *shakdo*, *gin shi bu ichi*, and rose copper. 4. *Sin chu* (brasses).—The finest quality of brass is formed of 10 parts of copper and 5 of zinc; a lower quality of 10 parts copper and 2·7 zinc. 5. *Kara kane* (bell metal).—First quality—copper, 10; tin, 4; iron, ½; zinc, 1½. Second quality—copper, 10; tin, 2½; lead, 1½; zinc, ½. Third quality—copper, 10; tin, 3; lead, 2; iron, ½; zinc, 1. Fourth quality—copper, 10; tin, 2; lead, 2. In forming the bell metals the copper is first melted, and the other metals added in the order given above. The best small bells are made from the first quality. Large bells are generally made from the third quality. The *kara kane* has a wide range of use in Japan. *Solders.*—For bell metal—brass, 20; copper, 10; tin, 15. For brass—first quality, brass, 10; copper, 1½; zinc, 6. For silver—silver, 10; first quality, brass, 5 or 3. For *gin shi bu ichi*—silver, 10; first quality, brass, 5; zinc, 3. For *mokume*—silver, 10; first quality, brass, 1½. For *shakdo*—fine *shakdo*, 3; zinc, 10. For tin—tin, 10; lead, 5. Among the Japanese articles made of copper that find their way to this country there are some with a bright red surface, which is often taken to be either a lacquer or an enamel. These articles are made of copper containing red oxide through the entire mass, and, after receiving the requisite form and a high polish, are boiled in the mixture mentioned above.—R. P., *Silliman's American Journal of Science and Arts.*

ROCKET APPARATUS FOR SAVING LIFE FROM SHIPWRECK.

FIG.14.

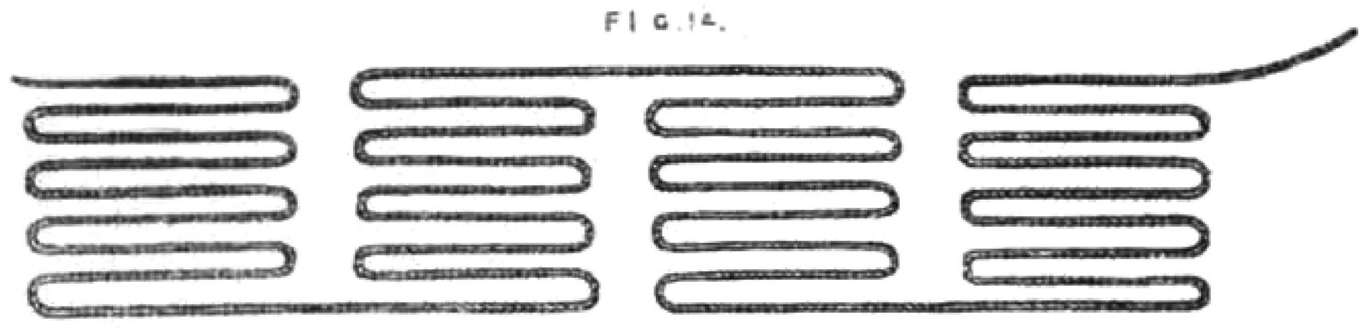

Fig. 14.—Shot Line as "Faked" by Manby.

FIG.15.

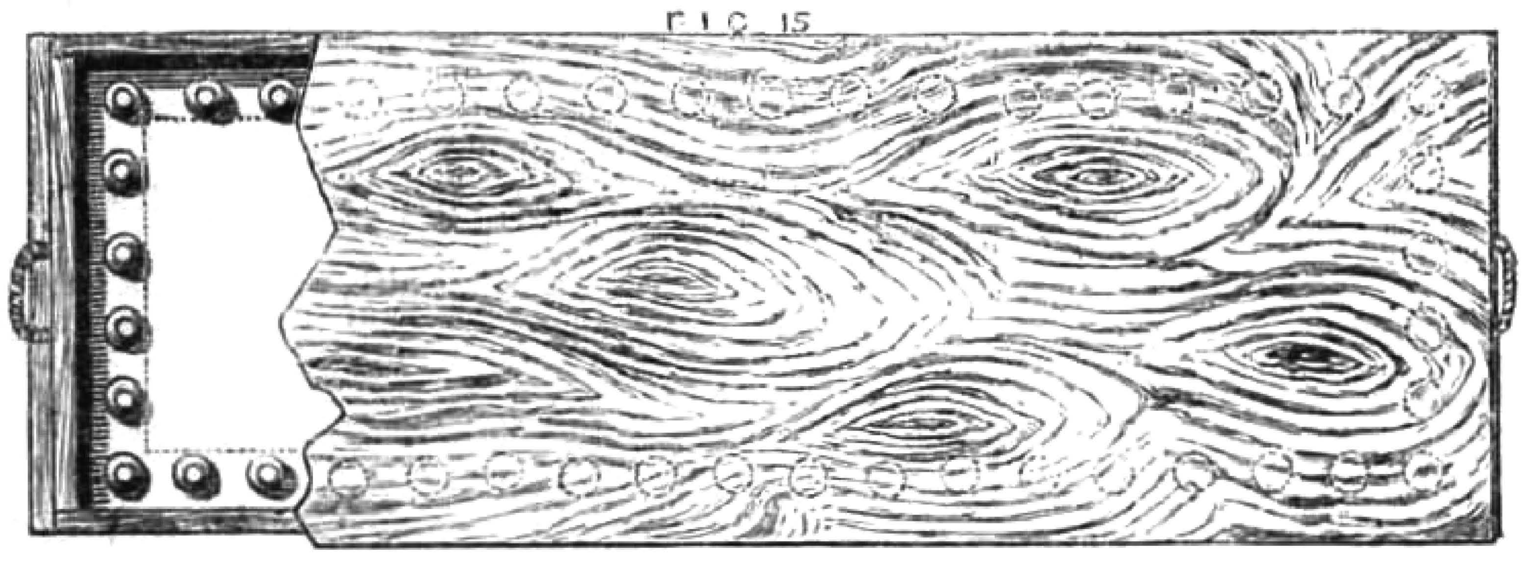

Fig. 15.—Dennett's Faking Box for Rocket Line (Plan).

FIG.16.

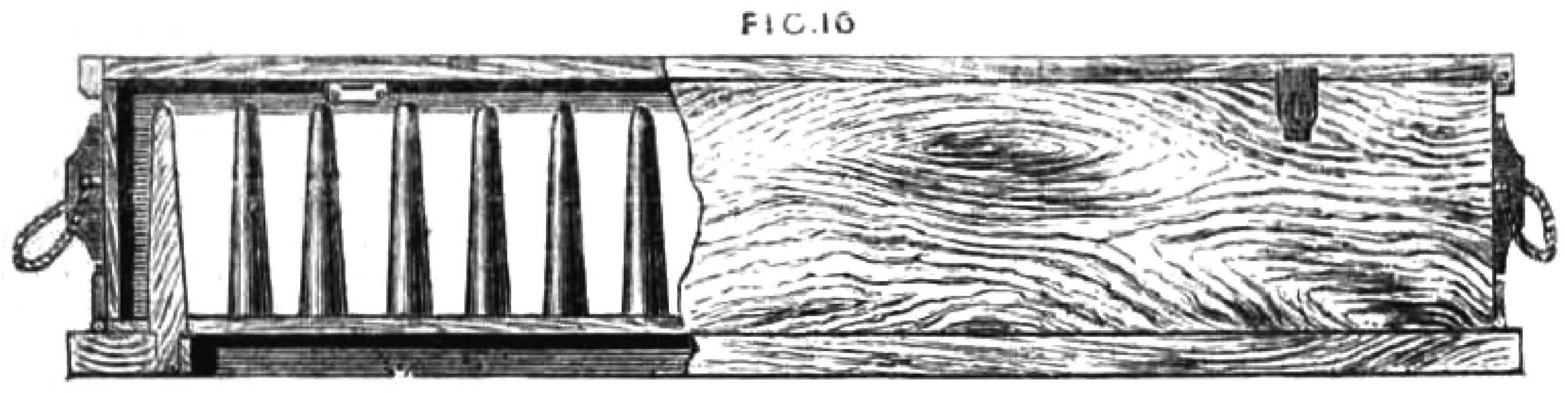

Fig. 16.—Dennett's Faking Box for Rocket Line (Section).

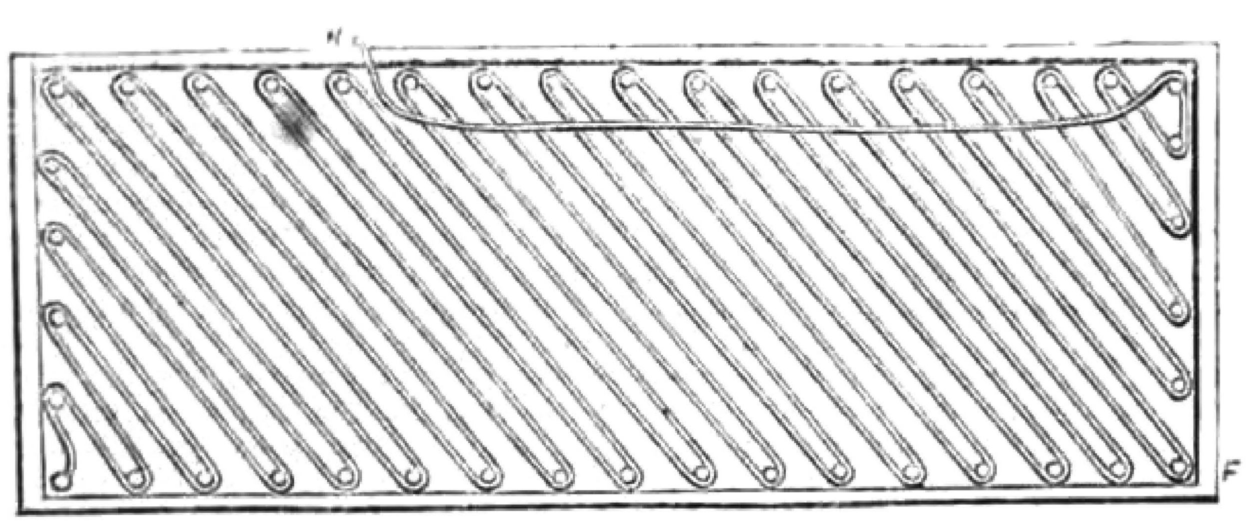

FIG.17.

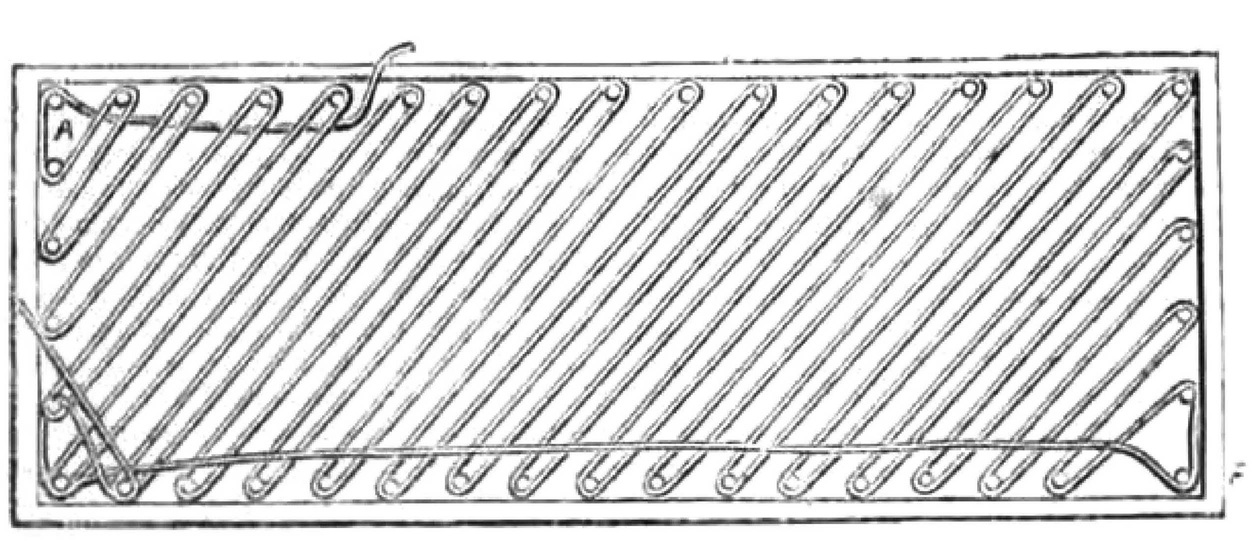

Fig. 17.—Line as Faked in Dennett's Box.

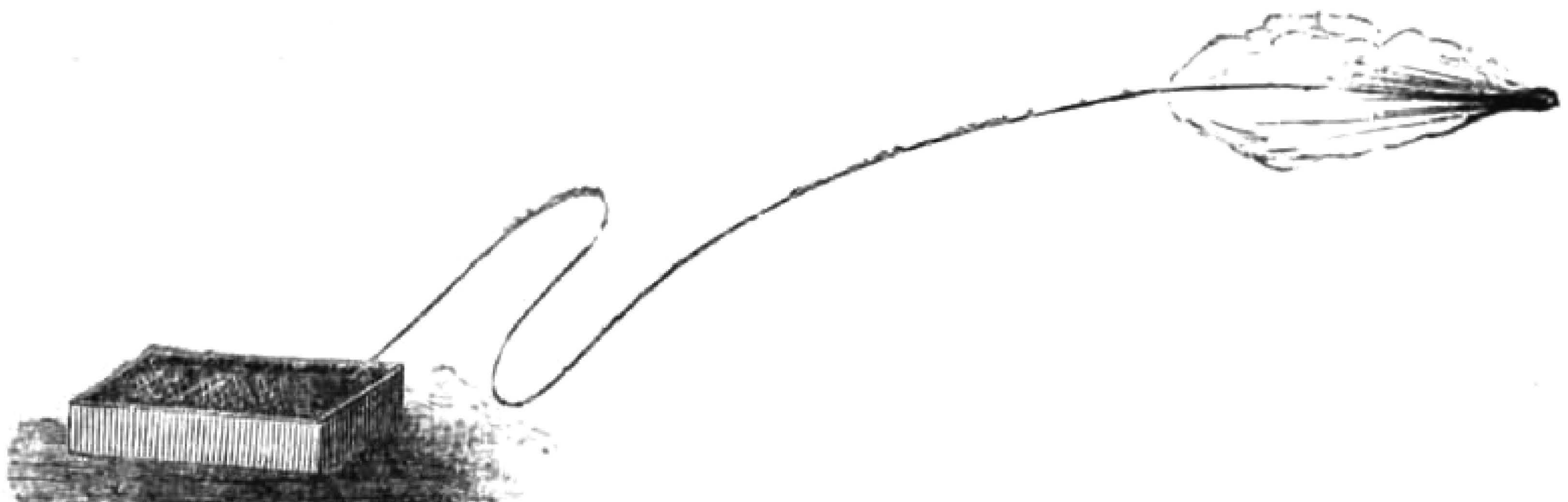

Fig. 18.—Rocket Line Leaving the Box.

FIG.19.

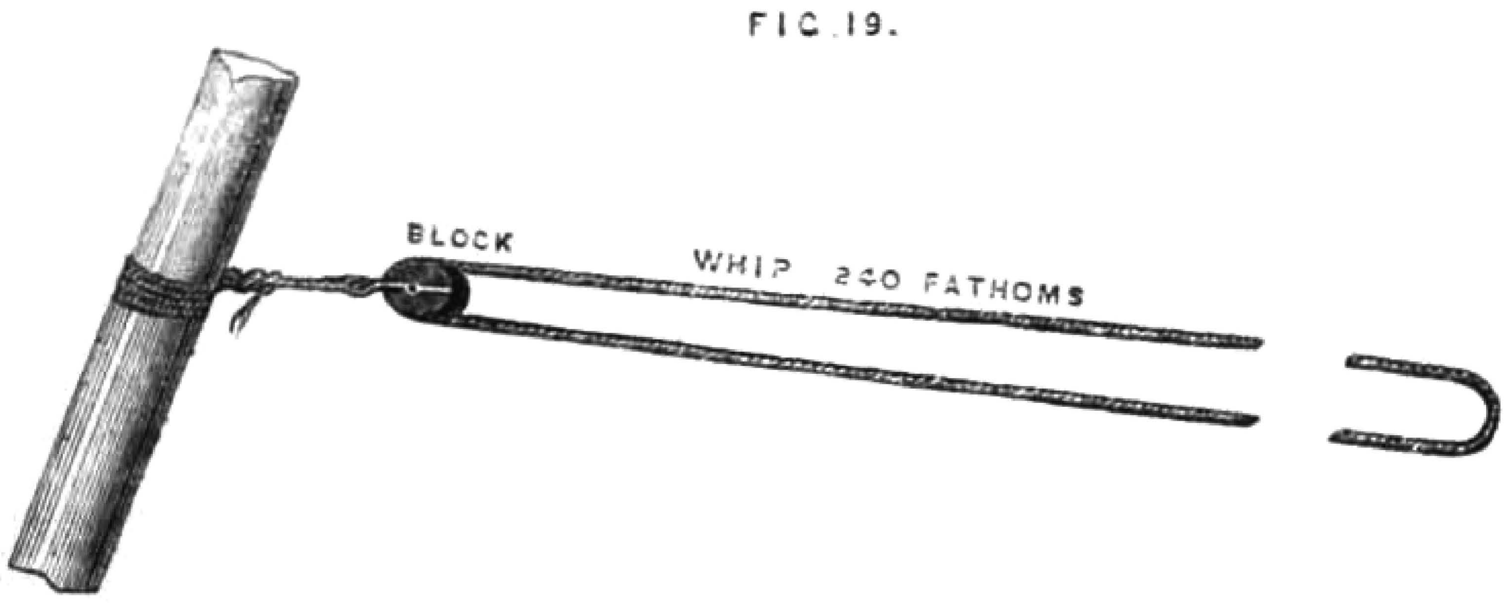

Fig. 19.—Endless Whip and Tail Block.

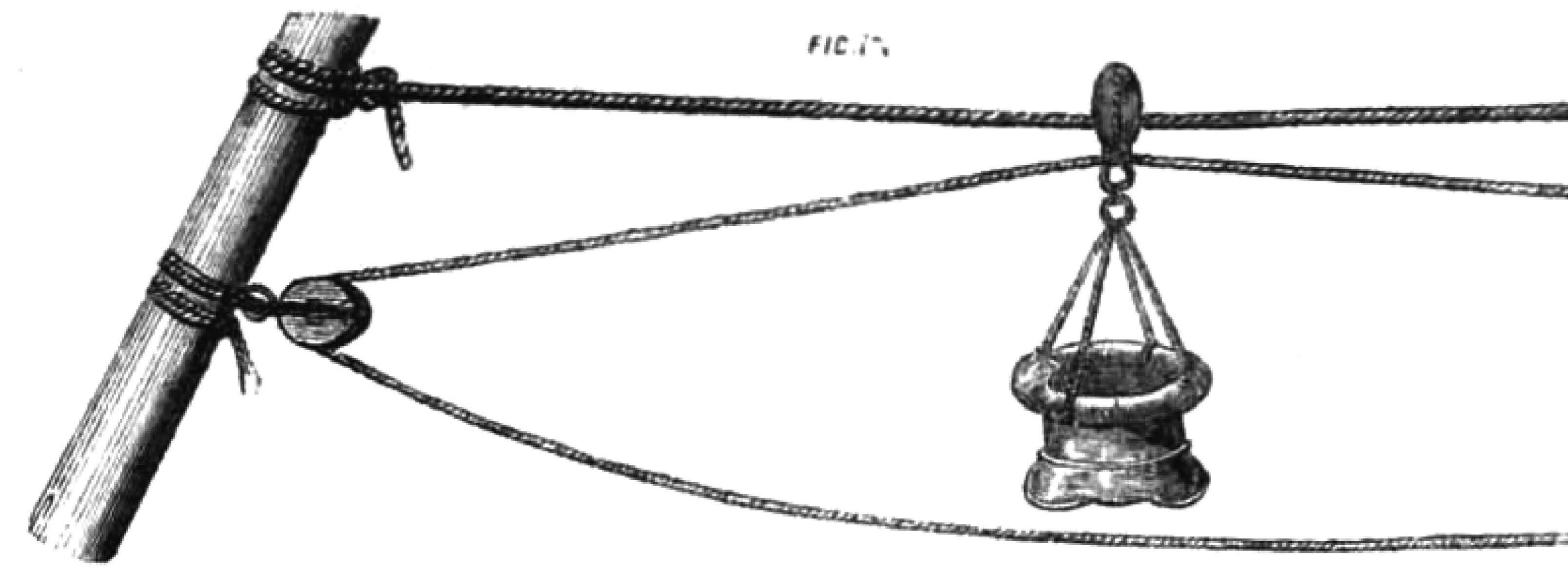

Fig. 20. Hawser, Whip and Chain or Petticoat Breeches.

Fig. 21.—Landing in the Petticoat Breeches.

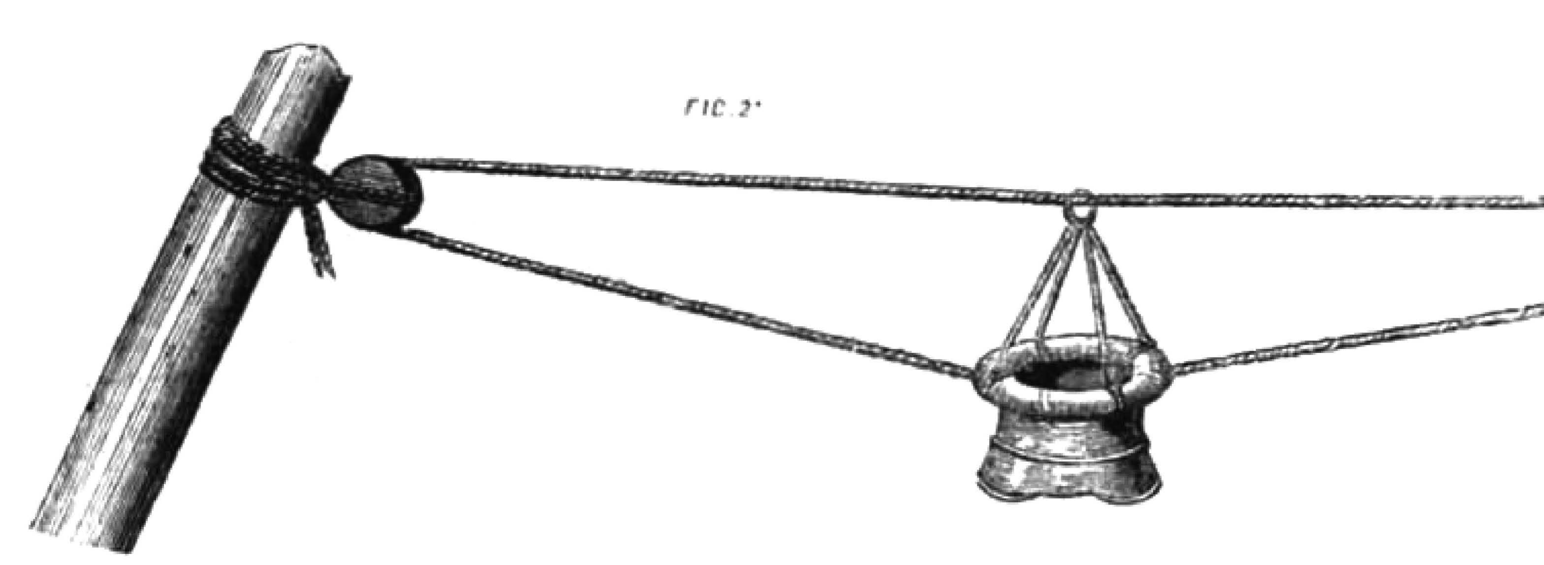

Fig. 22.—Whip Line Without the Hawser and Travelling Block on a Flat Shore.

FIG.22.

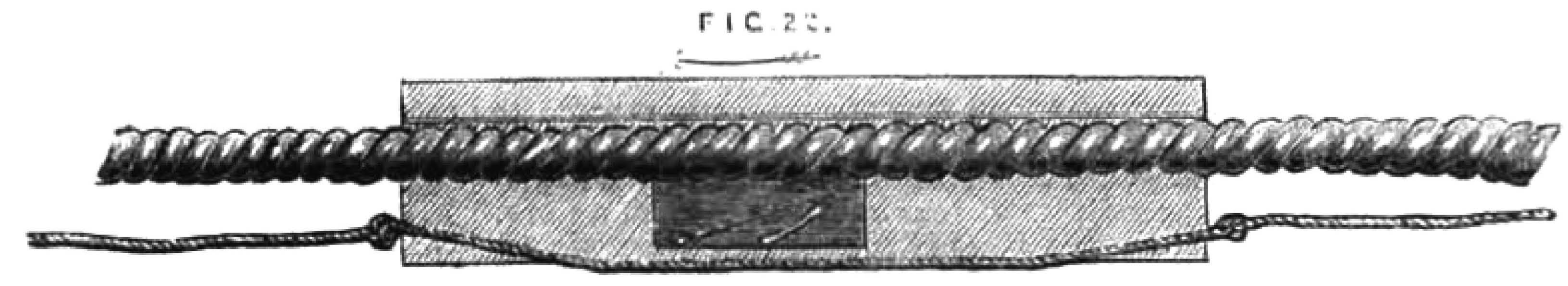

Fig. 23.—Pengelley's Cutter being Hauled off.

FIG.23.

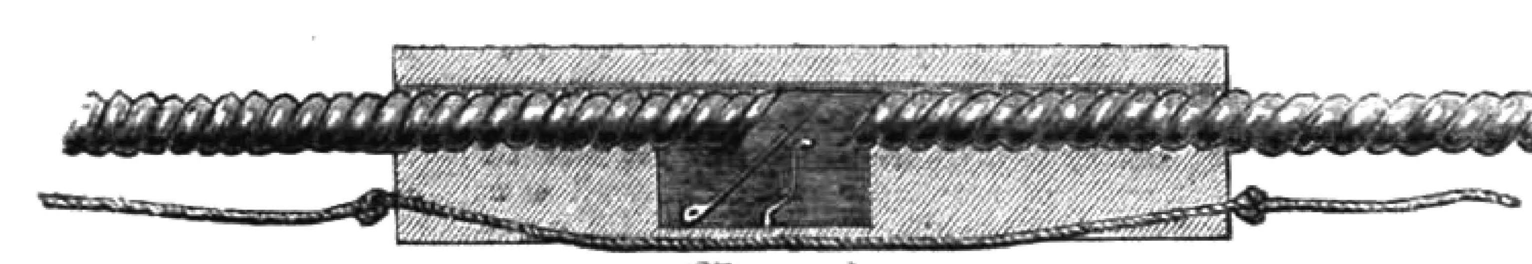

Fig. 24.—Pengelley's Cutter Cutting the Hawser.

FIG.24.

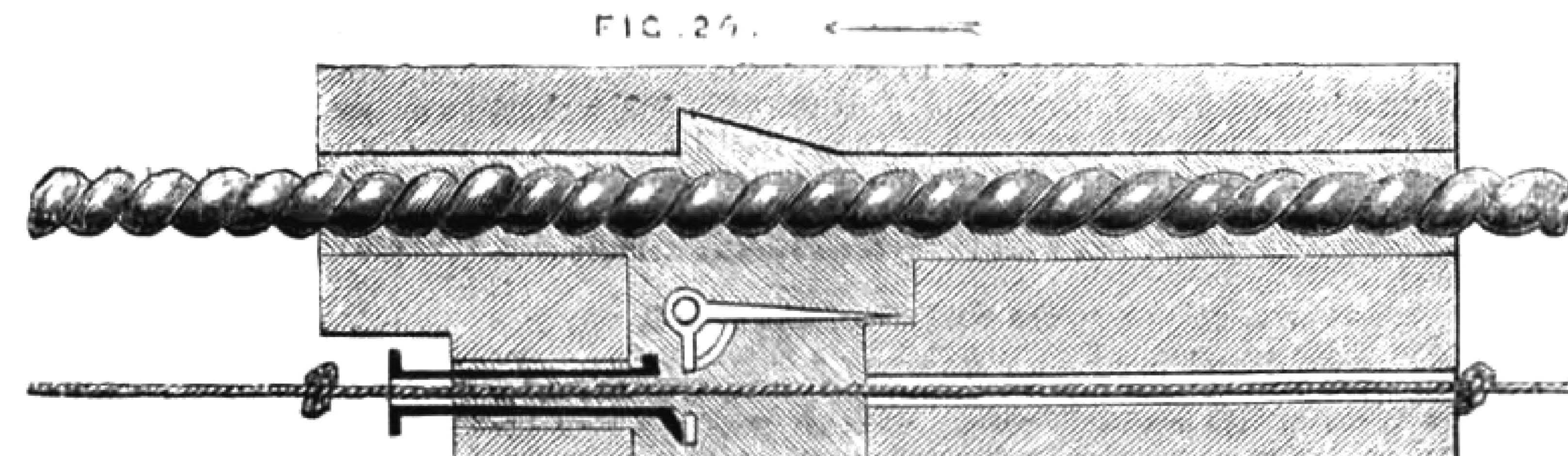

Fig. 25.—Improved Cutter being Hauled off.

FIG.25.

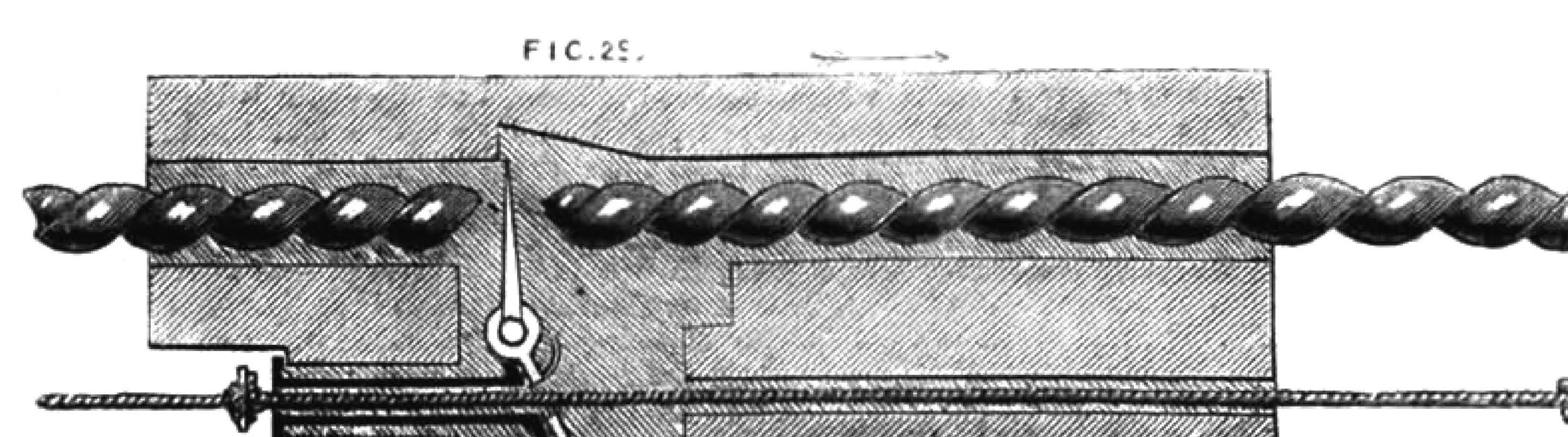

Fig. 26.—Improved Cutter, having Severed the Hawser.