

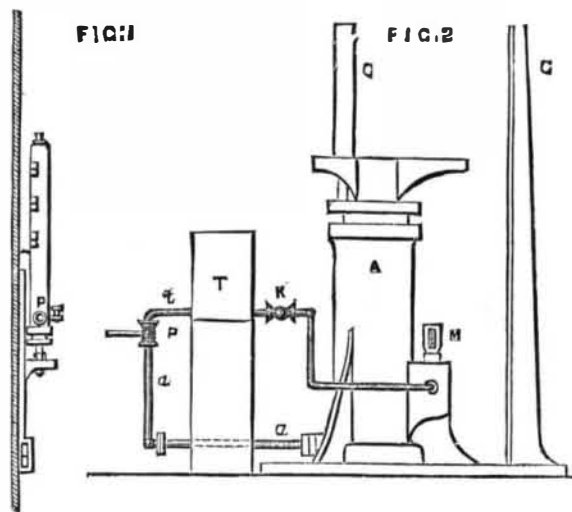
either to bring home disabled ships, or to take others to places wherein fair winds may be met with. For example, it is not improbable that the Stormcock may go to the Straits of Magellan, to bring home a large ship lying dismasted in a bay there, to which she was towed by one of our men-of-war on the Pacific station. More and more powerful tugs are being built daily, and it is not too much to say that the Stormcock is one of the most powerful, if not the most powerful, tugs in existence. She is the property of Mr. W. H. Hill, Liverpool manager of the Allan Line of steamers. She is 155ft. long, 25ft. beam, and draws 10ft. 6in. She is 90 tons register and 410 tons gross burden. She can stow 390 tons of coal in her bunkers. She is propelled by two pairs of compound engines, with cylinders 26in. and 45in. diameter by 30in. stroke, driving twin screws 9ft. diameter and 12ft. pitch. Steam is supplied by two cylindrical boilers, each 12ft. 6in. diameter, with three furnaces in each. The boilers face each other, and are fired fore and aft. The aft boiler furnaces are fitted with Martin's patent fire doors, which are in high favor with the stokers. The boilers are of 1½in. iron. The engines indicate collectively 1200-horse power, and the speed of the boat is over 14 knots an hour. She is built entirely of steel, and she has a steel upper deck, without planking. She has two oval funnels, is schooner rigged, and far more resembles a smart gunboat than a tug.

As she is used now and then as a tender to the huge Allan Atlantic steamers, she has, forward, a deck saloon of steel plates, with a pilot house and promenade deck on top. The saloon is lined with oak, sand-papered, and slightly oiled, but not varnished, and decorated with blue wall tiles, set in frames. The fireplace is in the old English style, with a carved mantel-piece and brass mountings reaching to the deck overhead. The front end of the saloon is semicircular. Aft, ample accommodation is provided for the captain and first and second engineers, while forward there is a roomy fore-cabin for the crew. The Stormcock was built and engined by Messrs. Laird, of Birkenhead, at a cost of about £16,000, and does the firm and her owner very great credit.

On Monday the Stormcock left the landing stage, and went straight out to sea. Two Durham governors are fitted on board, one for each pair of engines. They stand on brackets bolted to the ship's side close to the condensers in the wings, and take up little room. They are driven by ½in. thick gut bands from sheaves on the ends of the crank shafts just forward of the high pressure eccentrics. The morning was wet and calm, but as the day wore on the rain ceased, and a stiff breeze sprang up from the south-west, and by the time the Stormcock was an hour at sea she began to get lively. She had comparatively little coal on board, as she was going into dock to get her bottom cleaned—for the first time, we believe, since she was launched in the end of 1877—and the tips of her propeller blades showed above water while she lay at anchor in the river. The result of the trial was in every way favorable to the Durham governor. So long as the engines kept down to about seventy-five revolutions per minute there was no racing, but the moment she began to pitch as she felt the seas the governor began to act; and we can safely say that while there was no approach to racing the speed of the engines was never reduced below the normal velocity. The governor did, in one word, just what a watchful engineer would have done, only it did it better and more promptly. The sea was not sufficiently rough to bring out all the virtues of the governor, but it was quite rough enough to make it perform; and on one occasion, when for experiment's sake the governor on the port engine was thrown out of gear, racing at once began, and with it the ominous slap of water in the cylinders showed that the boilers were being made to prime. It is fair to Mr. Durham to add that those on board—and they were numerous—who represented the engineers and shipowners of Liverpool, agreed among themselves that the velometer would effectually prevent racing, without the introduction of any counter-acting disadvantage, an opinion in which we concur. The velometer is so simple that it requires little attention save to keep it oiled. A turn or two of the hand-wheel at the top of the spring box suffices to determine the number of revolutions which the crank shaft must make before it will act on the throttle valve.—*The Engineer.*

WATER-TIGHT DOORS FOR SHIPS.

To alleviate as much as possible the evil effects arising from the use of openings in the water-tight bulkheads of vessels, the following plan has been proposed by Mr. Riley, of H. M. S. Thunderer. By this plan the doors may be closed with greater quietness and quickness than they can be by any of the methods at present in use. Since the most serious results arise from not being able to close the doors with sufficient promptitude, the proposed plan has for its principal object the closing of the doors, the opening process receiving a minor consideration. The hydraulic

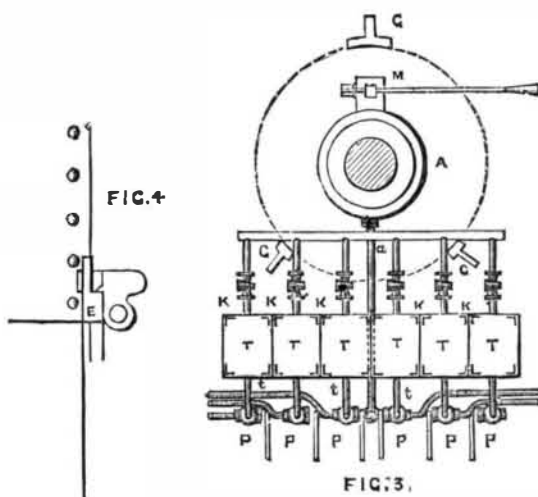


system is used; a system which has been applied before for the same purpose, but does not seem to have been taken full advantage of in the way of centralizing the process. In the proposed arrangement it is intended that the whole of the doors shall be under control from one central, secluded spot.

The system, as described, is applied only to doors which are raised and lowered to open and shut, as this kind of door offers peculiar advantages for closing. Most of the lower doors in present use in vessels are fitted in this manner, and if only these be brought under this method it would

greatly promote safety, as if the lower doors were quickly closed, it would allow time to close the upper ones before the water would reach too high.

Referring to the accompanying diagrams, Fig. 1 represents the hydraulic cylinder and door; P is the pressure pipe at the lower end of the cylinder; a cock or pipe leading to the bilge is attached to the upper end to allow any confined air or water, which may be above the piston, to escape. The pressure pipes at the bottom of these cylinders run to cocks, P, P, P, shown in Figs. 2 and 3; these cocks being fitted in order to put these pipes, P, in communication with the tanks, T, through the branch pipes, t, or with the accumulator, A, through the pipes, a. The accumulator, A, is a reservoir of pressed water for raising the doors; it is pumped up by hand by the small force pump, M, the supply of water being drawn from the tanks, T, and forced into the accumulator by raising and lowering the lever, L. Each door has its separate pipe and tank, the object of which will be seen hereafter. Let us now suppose the doors open, held in position by confined water between the piston at the door and the cock, the latter being shut off. In order to shut them, turn the handle of the cock from the horizontal position, upwards to the vertical position, thus putting the pressure pipe, P, in connection with the tank through the pipe, t; the door will then commence to fall by its own weight and force the water from underneath the piston into its tank. All the doors may thus be shut by simply turning their respective cocks. In order to make the apparatus as simple as possible, the accumulator is made only large enough for raising one door at a time, as there is plenty of time for the raising operation. To raise the door, the accumulator is pumped up with the force pump, the water being drawn from that tank belonging to the door which is to be opened, by means of one of the cocks, K.



When the plunger has been raised through a distance of 3 feet, the handle of the cock, P, is turned vertically downwards, putting the pressure pipe, P, in connection with the pipe, a, thus the pressure from the accumulator is transmitted to the piston at the door, raising the door as the plunger at the reservoir descends.

It will be noticed that the doors may be closed in the above manner at any moment without keeping or raising a pressure in the accumulator. It may, however, be objected that when a door is kept open by the confined water, the water will be subjected to such a pressure as will cause it to leak through the piston or glands. To prevent this, another element is introduced which will, in a great measure, do away with this objection, but at the same time will require a reserve of power to be kept in the accumulator. Check levers or catches are introduced, as shown in Fig. 4, capable of revolving upwards, but not downwards. When a door is raised to its full extent these catches are turned inwards into a slot cut in the door, so that the door as it falls may rest upon them, thus relieving the confined water from the pressure caused by the weight of the door. To close the door when these catches are in gear, it is necessary to turn the cock, P, putting the pressure from the accumulator on the piston, and raise the door 1½ in. or 2 ins.; in this ascent, the projecting piece, E, on the door raises the catch clear of the door, the catch being constructed so as to overbalance itself in this position; it, therefore, on being raised through a short distance, falls right away from the door. The passage for the descent of the door is thus made clear, and on turning the cock vertically upwards the door falls, forcing the water back into the tank. An accumulator, as shown in the sketches, loaded with one ton, 3-foot lift of plunger, 12-inch area of plunger, is capable of lifting over twenty doors of 800 lbs., each through the required distance of 1½ in. to relieve themselves of the catches. It would be advisable to use these catches under ordinary circumstances, when it is not probable there will be any serious reasons for closing the doors; though even if a necessity should arise they could be shut in less than two minutes. If, however, the weather is very stormy, or on entering an action, or in any like dangerous circumstances, it would then be better to let back the catches, ready to let the doors down at once.

The tanks, T, are divided one to each door to serve as indicators: as the door falls the water will be displaced from the cylinder above it and enter the tank, the position of the door depending on the water displaced. Thus the level of the water in the tank will indicate the position of the door, telling when it is closed, or if it is prevented from any cause. Care should be taken to keep the levels of the water in the tank at certain fixed positions, according as the door is open or shut; introducing a little now and then to supply any loss from leakage will be sufficient. The tanks should be graduated so as to read off at a glance the exact position of the door when lowering. The accumulator should also be graduated to serve as a guide for indicating the position of the door when raising it. The level of water in these tanks should be placed at or above the height of the piston when raised, so as to insure the cylinder beneath the piston being charged with water.

The catches mentioned could also be made to serve another purpose than that already given to it. If there are any compartments, having no egress independent of the doors in the bulkhead, a gong might be attached, so as to be struck by the catch on falling back, thus warning any who may be in the compartment to come out. G, G, G, are columns for guiding the weight on the accumulator.—*The Engineer.*

FOG SIGNALS.*

By J. R. WIGHAM

1. *Gas Guns as Fog Signals.*—The great importance to navigation of audible fog signals is now universally admitted. Among those which have been suggested are gas guns. Some years ago, when I was engaged for the Commissioners of Irish Lights in fixing gasmaking apparatus at several of their lighthouses in order that gas might be used instead of oil as the illuminant, it occurred to me that it would be convenient to use the gas available at such lighthouses for gas guns as fog signals. With the sanction of the Commissioners, I fixed gas guns of various sizes at Howth Bailey Lighthouse, and Dr. Tyndall and other gentlemen connected with the Board of Trade experimented with them. The noise of the gas gun is caused by the explosion of a mixture of oxygen and coal gas. We are all familiar with such explosions in the lecture room, but gas guns capable of producing a noise loud enough for a fog signal have only been tried, so far as I am aware, at Howth Bailey Lighthouse.

This mode of fog signaling has a very important advantage, viz., the gun may be fixed at the water's edge, or on a rock in the sea, at a considerable distance from a lighthouse or fog-signal station, and can be loaded and fired as often as required from the station without necessitating the light-keepers leaving their post, the noise of the explosion and the flash (in itself a good fog signal) being all the while at the point of danger. It is easy to imagine that such a point, say an isolated rock, might be too small to hold an ordinary gun, and be so inaccessible from the lighthouse as to render the attendance of a gunner almost impossible.

In order to show the section how these guns are used I have fixed one of small size in the College Park, which for the occasion we may call a dangerous outlying rock, and connected it by an iron tube with this lecture table, which we may call a lighthouse on shore. This gasholder contains the charge, which, of course, is gaseous, and not solid, as in the case of an ordinary gun. So soon as I have loaded the gun, which you will see that I do by simply opening a cock, I apply a light here at the shore end of the tube by percussion cap or otherwise, and the gun at sea is fired. It will be seen that the explosion very quickly follows the application of the light, so that these guns may be fixed at a great distance from a lighthouse or fog-signal station; a gas gun might thus be half a mile long. If the shots are required to succeed each other rapidly, any number of charges may be got ready to be successively used. I will now fire the gun which I have loaded.

I have only further to remark that the gun which you have heard is simply a piece of tubing 3 in. bore by 6 ft. long; the experimental gas guns at Howth Bailey are tubes about 18 in. bore by 9 ft. long, and are, of course, of enormously greater power. The sound of the Bailey gun is about equal to that of an 18-pounder cannon, and the expense of each shot of gas is also about the same as that of each charge of gunpowder for the cannon.

2. *The Irish Siren Fog Signal.*—I now propose to say a few words respecting another and perhaps the most important fog signal with which we are acquainted—the siren. In 1867, the United States Lighthouse Board made experiments with the first steam siren; the sound which it produced proved to be largely superior to that of the instruments previously in use—whistles, trumpets, etc. The Elder Brethren of the Trinity House and Dr. Tyndall subsequently made careful experiments with the American siren; and many instruments of the same kind have since been made and fixed at English lighthouses by direction of the Trinity House Corporation, by whom it is justly regarded as a most efficient fog signal. The siren has been so well described by Dr. Tyndall, Sir William Thomson, and Sir Richard Collinson, that I need not now describe it, and will only say that the instrument which I have here, and which I have called the Irish siren, is adapted either for steam or compressed air, and differs from those made in America and in England in being driven by a species of small turbine actuated by the current of steam or air by which the instrument is sounded, the rate of rotation being controlled and rendered uniform by a simple governor; a much less complex arrangement than the somewhat cumbersome mechanism which has heretofore been used. The Irish siren is applicable to steamships as well as to lighthouses. The first I made was similar to the American instrument, having two perforated disks, one revolving in front of the other, but with one important difference, that the holes in the revolving disk were constructed with beveled edges, and it was thus caused to rotate by the direct action of the steam without the intervention of any machinery, precisely on the principle of the original siren invented by Cagniard de la Tour.

The siren thus constructed is particularly suitable for steamships, being so simple that the smallest boy in the ship can set it to work in a moment by merely turning on the steam. This arrangement, though satisfactory for ships, was not so good for lighthouses, where the sound is required to travel to a greater distance. It was found that the speed of the disk became so great as to produce a note so high as to be almost inaudible; and although the dying shriek of the siren, as it approached the point of inaudibility, was peculiarly weird and unmistakable, and such as a few years ago would have been considered perfectly to have fulfilled the purpose of an effective fog signal, yet it was found to be inferior in range and power to that of the prolonged uniform note which is to be obtained by the use of some kind of driving machinery by which a regular rate of rotation of the disks is maintained. Instead of disks, as in the American sirens, I now use two concentric cylinders, one fixed, the other revolving. I believe that this part of the apparatus was invented by Mr. Slight, the foreman of the workshops of the Trinity House Corporation; but the chief peculiarity of the Irish siren to which I call your attention consists, as I have said before, in the simple means by which the cylinder is made to revolve, as will be seen by inspection of the instrument on the table.

As the song of the siren, if raised within the precincts of Trinity College, might be found inconveniently loud by the members of the British Association, especially by those gentlemen who might be in the act of reading papers, it was arranged to place it in the courtyard of the Royal Dublin Society's premises, and to sound it occasionally during the evening of the conversation which was held there. It was doubtless heard by many of the members of the section who were present.

The great advantage which I claim for this siren above all other forms of the instrument with which I am acquainted consists in this, that from the compactness and simplicity of

* Read before the British Association, Dublin meeting.

the arrangements by which it is driven, and from the fact that it is not necessary that it should be united by belt or otherwise with any motive power, it can be sounded at the water's edge or on an outlying rock, or at any position no matter how distant from the station at which the steam boiler or compressed air receiver is situated.

IMPROVEMENT OF PRAIRIE ROADS AND STREETS.*

By T. J. NICHOLL, C. E.

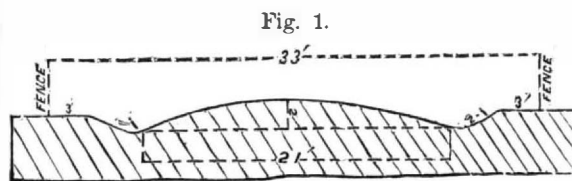
THE great State of Illinois at present ranks among the foremost in the Union, and has, lying within its boundaries, the soil, the mineral, the fuel, and the intelligence, to make it not only the pride of every American citizen, but one of the most powerful States on the face of the globe. To bring such a state of affairs about, the very highest development of its immense resources will be necessary, which can best be accomplished by making the transportation of produce and manufactures easy and certain at all seasons.

The improvement of rivers, and the construction of canals and railways, have done, and are doing, a very great work in the right direction, but they will never be operated economically, or the full extent of their usefulness reached, until the proper improvement of our roads and streets is an accomplished fact. We might say that almost every atom and source of wealth of this great country has, of a necessity, to pass over country roads before it can reach the great commercial arteries we call rivers, canals and railways, and if for six months of the year these roads are impassable, as a natural consequence our business and prosperity must receive a check each year that can scarcely be calculated. This we know to be a fact, yet we do not acutely realize it, until we stand on the pinnacle of our possible attainments, and consider the present condition of our so-called roads.

Now, what I have said in regard to Illinois is equally true

air and sunlight to dry it out. Thirty-three feet is ample width, except in some few cases, for a prairie road, measuring between the fences; this will give 3 feet on each side next to fence and 27 feet for roadway and ditches, which you will admit is more than is usually required. Sidewalks in the country are unnecessary, as tramps or other pedestrians generally take the center of the road; any space left for such would only grow up in weeds.

Fig. 1 will illustrate the form of cross-section proposed, except that I would change the radius of the arc used to suit the material and locality. For the ordinary black loam, where the country is comparatively level I would give the



arc a radius of about 30 feet; this as per Fig. 1 would give a filling in center of road about 1 foot, which would be 2 feet above ditches.

The ditches should be 1 foot deep, 1 foot on bottom, with outside slope 2 to 1, inside slope being that of roadway. Of course this idea can only be carried out on mostly level country, as in localities where land is rolling and broken or swampy, the surface will determine the depth of ditches and excavations and height of embankments; but in all cases ditches must have sufficient grade to carry water to first natural channel, and roadway be maintained to a width not less than 16 feet; in doing this more right of way would often be required. Now, having explained the form, I will

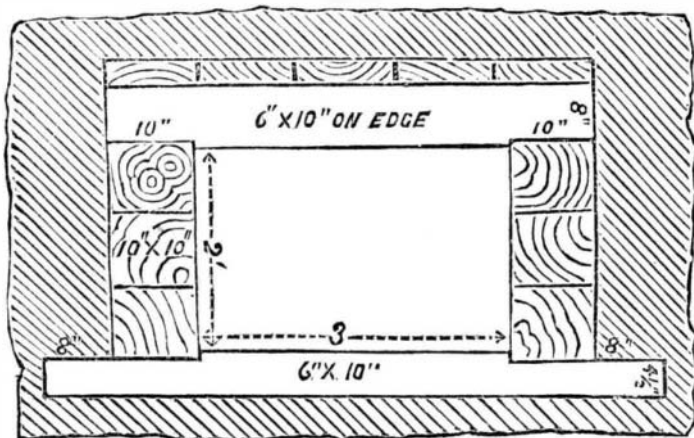
loam of the prairies is not far below it for wear and in shedding water. The soils are not so much at fault as has been the common method of using, or rather misusing them.

Early in spring or late in autumn are the times chosen for building country roads, because the farmer can best spare the use of teams, men, tools and time. They begin by plowing over a space about 10 feet wide, 15 or 20 feet from center on each side; the material thus loosened up is scraped toward the center without any particular regard to form in most cases, but occasionally they will level it off a little with shovels, or by dragging a railroad bar over it, and the road is complete. The consequence is, they try to use the so-called road, but as the wheels sink too deep in the soft earth, cannot, and the spaces from which the material was taken is used instead. After numerous trials and the effects of weather, the ill-shaped embankment gets solid enough to use, and makes a passable track until the rainy season sets in, when it is soon churned up into ruts and holes unfathomable, and is again abandoned for the side spaces, which do not last long, and the whole right of way becomes an impassable mud puddle until the dry season, when generally by use, but often by repairs, it is made good, by filling up with loose dirt, which a little travel after first summer rain soon churns out, making the road if possible worse than before repairs were made. Thus the people go on spending their money and working out their poll tax, getting no return except that which is against themselves in the way of worn-out horses and broken wagons, not mentioning losses in the sales of produce, etc. How long they can stand this species of extravagance is for them to say.

So far nothing has been said in regard to culverts and small bridges, which are much needed and of a different style to those in general use on our public roads. The large bridges, being usually designed and built by reputable bridge engineers, are generally very good.

The first and most important things to be considered in bridging are the location and size of opening required; the

FIG. 2.



of its neighboring States, having used it simply as an example from my better acquaintance, and believing it to be a fair one. Bad roads are a great detriment to the advancement of civilization, and prosperity in any country, and a bad prairie road or street is certainly the worst in existence. This is pretty well understood by most members of our club, and the remedy, if there be one, should very properly emanate from us as a club, being representative of the engineering profession in the Northwest. To this end I hope you will impartially and thoroughly discuss this important subject, and arrive at some conclusion that may give the country, and towns and villages of prairie States, relief in this matter.

Having thus briefly opened the subject, I will proceed to give you some conclusions arrived at after having given the matter much careful thought and observation, believing that the remedy is not far distant, nor the cost beyond the present limit of the people's means.

state how I think work should be done, so as to make prairie roads passable at all seasons. First, I would have levels taken and grades of road and ditches established in much the same way as we do for a railway; would then make excavations and embankments in accordance therewith, using the plow and scraper and being careful to get embankments full, allowing two-tenths to a foot in height for settling; when this was done I would plow up the roadway proper in cuts and where the filling was light, harrowing or raking the surface to proper form, cleaning out ditches neatly with shovels. Now I would roll the bed so formed, with, say, a 2-ton horse roller, after which I would fill up any little unevenness or holes, and roll the whole with a 15-ton steam roller of the Aveling and Porter pattern, beginning in the ditches and rolling to the center, except on embankments, where it might be found necessary to roll the center first; but in this country there are so few places that would require embankments, that it is scarcely necessary to

former can generally be determined by the lowest ground, the latter requires a knowledge of the amount of water to be carried. My plan has always been to hunt up the oldest inhabitant and from him get an idea of the extent of the largest and most destructive freshet in his memory, or that he may have heard of. I then calculate the size necessary to allow such a flood to pass off, multiplied by two, and that is about as near as you can get to it, in the West. It is my opinion that, when a culvert is required at all, it should never be less than 3 feet wide and 2 feet high, so as to admit of its being properly cleaned out. I would build them as per Fig. 2, the walls being of 10x10 oak 18 feet long, laid on mudsills 6x10, 6 feet long, 4 feet between centers, gained down at ends to receive walls and keep them from closing in at bottom. The stringers or floor beams may be of same size, fitted in same manner and distance apart; ends being flush with outside of wall and bolted to same with one-half inch drift bolts, 10 inches long, to keep them in place;

FIG. 4.

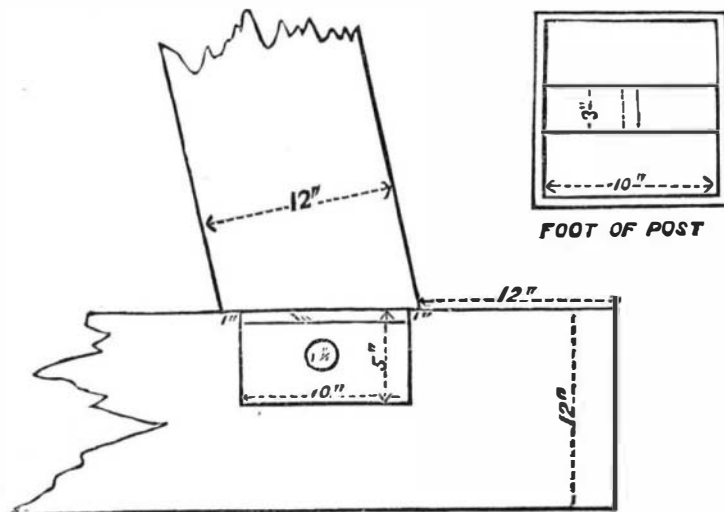


FIG. 5.

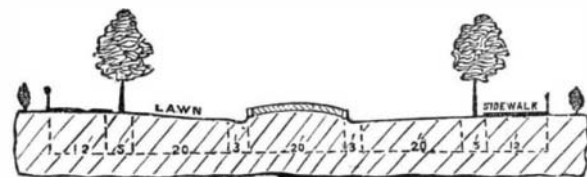
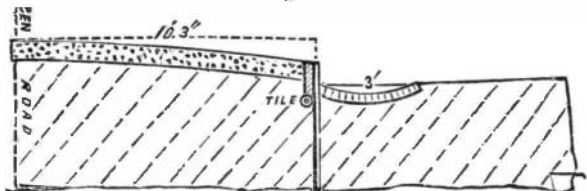


Fig. 6.



While the general surface of our prairies is flat, still there are undulations sufficient if properly used to carry off all the rain or water that may have accumulated in years past, to the Mississippi, Ohio, or other large rivers, and these undulations occur so frequently that main ditches would not have to be dug for any great distance to reach them. Thus it will be understood that good drainage, "the very foundation of good roads," is possible, and upon the possibility of the efficient drainage of our prairies I base the assertion that very fair passable roads can be made out of the soils we have at hand.

Public roads in the West are almost universally laid out sixty-six feet wide, about one-fifth of which is used, and the balance is allowed to grow up in weeds, which are vile smelling, unsightly and injurious, both to adjoining farms as well as to the roads themselves, keeping the surface damp, and making the ground porous, so that the first autumn rains make the road muddy, with no chance for the circulation of

mention them; in the large majority of cases the ditches will afford all the material required to make the roadway. Roads of this kind should be made in the months of July, August and September, not later, and should be rolled twice or three times within a month after they are made. This will give them a proper time to harden and settle before the rainy season begins, and will reduce them to a compact mass the depth of one plowing, so that in an ordinary season a loaded wagon will scarcely make an impression, except immediately after a rain, and then only about one-fourth of an inch deep below the surface. Should small ruts form or dust accumulate, they should be filled and rolled again after first rain, as upon the compactness of the particles will depend in a great measure the durability of the road. Some of you may have serious doubts as to the soils of our prairies having the proper ingredients to shed water. I have not, having observed closely their use in the surfacing and building of railways.

The white clay of the oak ridges is very good, and as ballast, in my opinion, is next to gravel, and the regular black

on these may be spiked a 3 inch oak or pine floor, and you have a culvert completed that will give you no trouble for 10 or 12 years.

This same form of culvert might be used with some modifications (in size of stringers and use of three-fourths inch iron dowels in walls) to a height of 5 or 6 feet and 10 feet span, but where they are greater it will be economy to frame trestles of 8x8, 10x10, or 12x12 timbers, according to height required, composed of 4 posts, cap and sill, the posts being mortised into cap 5 feet apart between centers, the two center ones perpendicular and two outsides with 3 inches to a foot batter, the sill being of sufficient length to receive them, and the whole put together as per Fig. 3. On these bents will rest the longitudinal beams or stringers, 4 in number, varying in size according to span, which should not exceed 20 feet, the most economical size for which would be 7x16. These should be drift bolted to caps, and the 3 inch floor spiked to them. All bridges having a span of 10 feet and over should be provided with substantial hand rail. The form of mortise and tenon I would recom-

* Read before the C. E. Club of the N. W., September 3, 1878.