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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

Enclosed Shipbuilding Berth for Canadian Vickers, Ltd.

Speedy Erection at Montreal of Double Berth 500 ft. Long by 152 ft. Wide—Can Accommodate Freighters of Ten Thousand Tons Carrying Capacity—Largest Totally Enclosed Berth in Canada, Requiring a Thousand Tons of Steel

THE largest enclosed shipbuilding berth in Canada has just been completed at Montreal for Canadian Vickers, Limited. It is a double berth, 500 ft. long, 152 ft. wide, 74 ft. 3 ins. from the floor to the underside of the bottom chord of roof truss at the land end and 99 ft. 8½ ins. at the water end, and includes about 1,000 tons of steel. The overall height at the water end is 110 ft. 6½ ins. Each section has 69 ft. clear width between steel, each crane span being 70 ft.

Freighters up to 10,000 tons capacity can be built in either section of this berth, but it is now being used largely for the construction of smaller boats, and since the completion of the berth it has at times accommodated as many as eleven ships at once. In all of the accompanying illustrations can be seen preparations for laying the keel of a boat even before the completion of the berth.

Fig. 1.—Interior View of Berth, Showing Both Sections. Looking Toward Land End. Beyond Columns at the Left is Another Covered Steel Berth. Beyond Columns at the Right is a Covered Wooden Berth

Canadian Vickers, Limited, have one other covered berth, 120 ft. wide, all in one section, which can accommodate a bigger boat than the new berth even though the latter is 152 ft. wide, owing to the fact that the new berth is divided into two sections.

The new berth is built on a natural slope which is 10 ft. in 160 ft. at the water end, then 15 ft. 5½ ins. in 330 ft., the last 10 ft. at the land end being level. The columns were erected on concrete footings, built on piles.

The berth occupies all the space between two other large buildings of the Vickers plant, so that no side walls were necessary excepting on one side for a comparatively short distance where the berth extends further than the wooden building which adjoins it on that side. On the other side is a long modern steel building which was almost entirely glass on the side facing the new berth. Fig. 2 shows the start of the erection of the first section of the berth and the glass side of the adjoining steel building. This entire side was later removed, as can be seen in Fig. 1, which is an interior view of the berth when nearly completed, also showing (on the right side) the interior of the wooden building, one wall of which was likewise removed, thus practically throwing the three buildings into one.

The roof of the berth consists of 3-in. x 1½-in. boards laid on edge and spiked together and to a nailing strip on the purlins. The purlins are at 9-ft. 6-in. centres. A continuous skylight, 16 ft. wide, runs the whole length of the berth over the centre of each section. On the side adjoining the wooden building there is a steel framing, with wooden window sash, 20 ft. high, above the roof of the wooden building, thus providing ample light.

Each of the centre columns of the berth consists of two 24-in. Bethlehem I-beams, latticed at 2-ft. 8-in. centres with 3-in. x 2-in. x 5/16-in. angles.

The side columns next to the steel building are 10-in. x 10-in. Bethlehem H sections, attached to the columns of the adjoining building. Next to the wooden building the side columns consist of two 20-in. Bethlehem I-beams latticed at 2-ft. centres with 3-in. x 2-in. x 5/16-in. angles.

The Warren roof girders are 9 ft. 6 ins. deep at the centre and 7 ft. 7 ins. at each end, made up of 6-in. x 6-in. x 7/16-in. angles, the centre panel, carrying the skylight, being reinforced by a pair of 6-in. x 4-in. x ½-in. angles at the top and by a pair of 5-in. x 7/16-in. flats at the bottom.

The purlins are pairs of 4-in. x 4-in. x 5/16-in. latticed chord angles, all 4 ft. deep excepting at the ends of the berth, where they are the full depth of the truss, to carry the bottom chord bracing, as all the wind bracing is in the

end panels. A 6-ton travelling crane serves each section. The crane girders are straight Warren trusses, 7 ft. 3 ins. deep, each top chord being a pair of 12-in. channels, and each bottom chord a pair of 6-in. x 3½-in. x ⅝-in. angles.

The roof of each section has a slope of ¾ in. to the foot. Approximately 85,000 sq. ft. of prepared roofing was used in covering the berth.

Anglins, Limited, Montreal, were the general contractors, the berth being designed and erected under the supervision of H. H. German, chief naval architect for Canadian Vickers, Limited. The steelwork was designed, fabricated and erected by Canadian Allis-Chalmers, Limited, under the direction of J. L. Brower, manager of the bridges and buildings department. Jas. Findlay was superintendent of erection.

Mr. Findlay greatly simplified the erection problem by taking advantage of the adjoining steel building. He

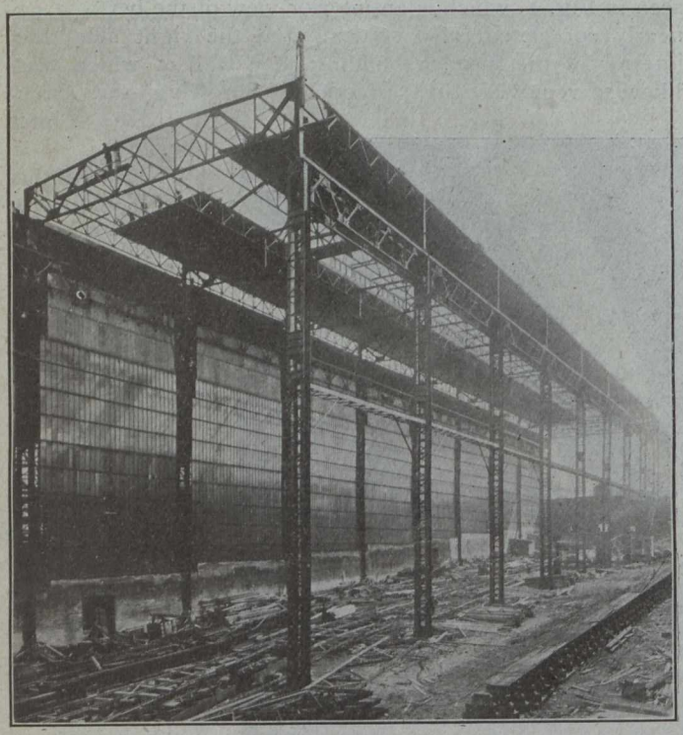


Fig. 2.—Erection of First Section of Berth. All the Glass and Sash in the Side of Adjoining Building was Later Removed

erected a guy derrick at the top of one of the columns of the old building, and placed the steel for 100 ft. of the first section of the berth, then shifting the derrick 100 ft. to a column in the next panel. After the first section was in place and nearly all riveted, the derrick was shifted to the centre columns of the berth, and the steel for the second section was placed. Figs. 2 and 3 show the steel for the first section being placed, and Fig. 4 shows the first section completed and start just being made on the second section. The first truss was erected on April 4th, 1917; the last, on June 2nd.

The land end is sheeted with metal, and the water end is partially closed by a flitch dam and superstructure, above which sheeting is carried to the roof, thus totally enclosing the berth so that ship-building operations can be continued all year regardless of the weather conditions.

The Dominion Bridge Co., Limited, designed, fabricated and erected the steel work of the flitch dam for E. G. M. Cape, who was the general contractor for the dam, having previously built a similar dam for the first Vickers berth.

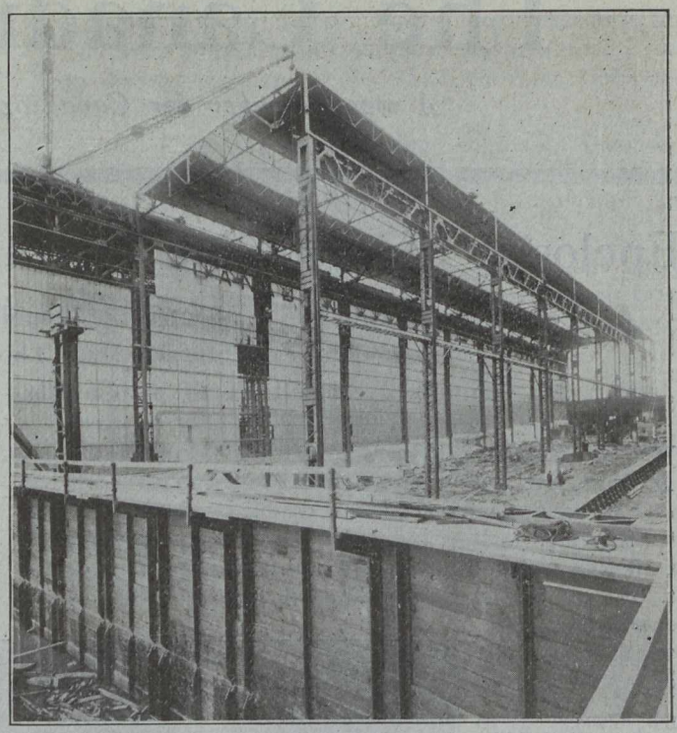


Fig. 3.—Flitch Dam in Foreground. Also Showing Method of Erection of First Section

The water end of the berth floor is 23 ft. below the St. Lawrence River level at high tide, thus affording ample water for launching. The flitch dam keeps the water out of the berth while the boats are being built, and when they are ready for launching, a ten-ton hoist which is hung on the roof at the water end of the building, picks out the various parts of the flitch dam and its superstructure, thus opening the entire end of the berth and providing a passage for end launchings.

The top of the wall of the flitch dam is 25.47 ft. above the low point of the berth, or level with the high point

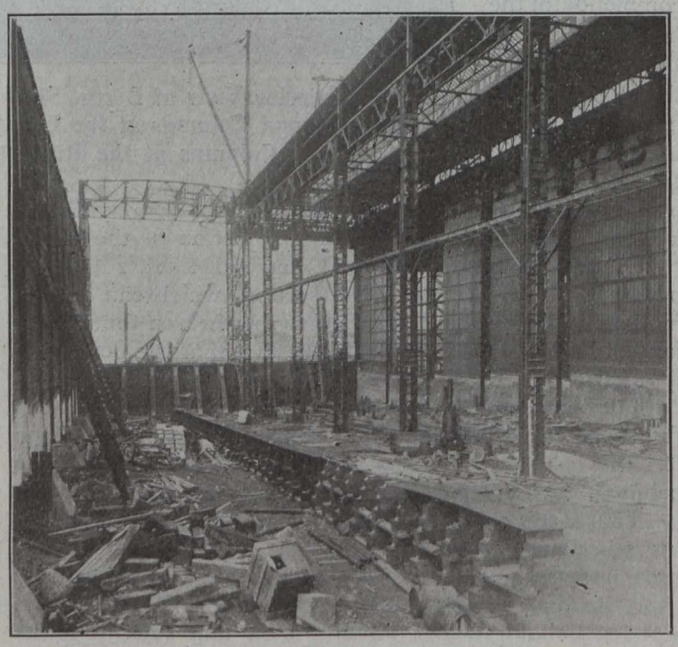


Fig. 4.—First Section Completed and Start Being Made on Second Section. Looking Toward Water End. Note Struts in Background, Bracing Flitch Dam

of the berth floor. The dam framing consists of a number of built-up tapered box girders, made up of a 6-in. x 6-in. x ½-in. angle at each of the four corners, covered on three sides with ⅜-in. plate. The width of the face of the girders is 32 ins., the width of the tapered sides being from about 4 ft. 6 ins. at the bottom to 3 ft. at the top.

These girders are braced with struts consisting of two latticed 15-in. channels. These struts can be seen clearly in Fig. 4. The struts are braced against a reinforced concrete slab, built on piles, which runs across the face of the double berth with a spread of 19 ft. inside of the centre line of the girders. This slab is 9 ft. 6 ins. deep under the girders, tapering off to 5 ft. under the struts, each of which is bolted with two bolts to a steel grillage set in the concrete.

There is an anchor bolt from the outer face of each box girder to a steel grillage set in the concrete slab.

The box girders are spaced from 11 ft. to 19 ft. 9 ins. apart, centres, the space between them being filled with the logs. Fig. 3 shows the outer face of the flitch dam. On top of this dam (the top being braced by a girder consisting of two 10-in. channels, latticed 3 ft. back to back with 2½-in. x 2½-in. x 5/16-in. angles) a number of lighter girders, 48 ft. high, are placed at 11-ft. 8-in. centres and bolted at the top to the wind girder and

Fig. 5.—One Section of Completed Berth, Looking Toward Land End. Note Preparation for Laying Keel of Ship

at the bottom to the 10-in. channel strut, and four square steel frames, filled with 4-in. plank, are dropped into grooves between each pair of these girders. Above these frames the end of the berth is sheeted to the roof. When ready for a launching, the bolts fastening all of the frames, girders, struts, box girders, etc., are removed, and all parts are swung clear of the end of the berth by the aid of the hoist on the roof.

PIT-RUN GRAVEL CONCRETE USED FOR PAVEMENT SUB-BASE AT LONDON

As a result of the dispute between Sir Adam Beck and the city engineer of London, Ont., regarding the quality of the concrete base for pavements in that city, the mayor appointed R. J. Marshall, B.A.Sc., instructor in the department of applied mechanics of the University of Toronto, to make a report upon the whole subject. Mr. Marshall's report shows the danger of

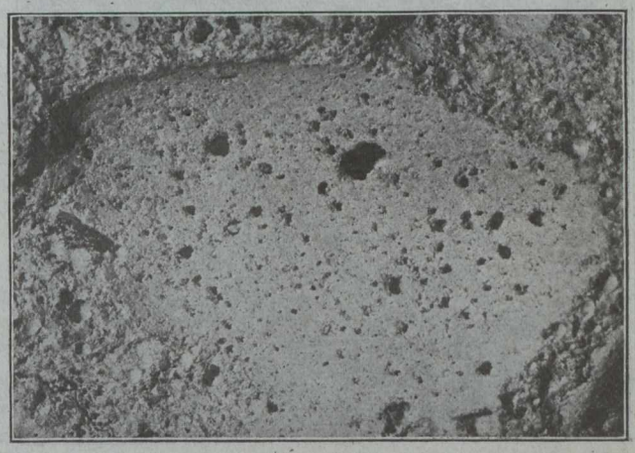


Fig. 1.—Showing Mortar Bedding of Stone Taken from 6-in. Cube

using pit-run gravel for concrete without screening and grading—and then, of course, it's no longer pit-run material. The following is an abstract of Mr. Marshall's report:—

This report is made from an examination of the roadway sub-base as seen on Richmond Street and Beaconsfield Avenue, where the sub-base was exposed. Samples of concrete taken from the pavement and some 6-in. cubes were tested. Samples of the gravel were taken from the material piled on Beaconsfield Avenue, where on account of the high water, both the pit and river gravels were to be used.

The two samples of gravel were divided into sand and stone by sieving the material on a standard ¼-in. sieve. The material passing the sieve was taken as sand and that retained was considered as stone. The following proportions were found:—

	Sand.	Stone.
River gravel	58.2%	41.8%
Pit gravel	49.8%	50.2%

These samples were a fair average of the quality of the material piled on the street. Some samples might be found which would run higher in percentage of stone, but undoubtedly there were samples poorer in stone content.

The specifications in use for this work require one part cement to eight parts of good gravel containing not more than 40% of sand; then, it is specified that all stone mixed with the concrete shall pass a 2½-inch ring. I am convinced that 90% of the material which I saw would not fulfil the specifications with regard to relative proportions of sand and stone; also stones of as great as five inches in diameter were to be seen, mixed in the concrete of the sub-base and also on the piles on Beaconsfield Avenue.

The purpose of the specification is that the cement added should fill the voids in the sand, and this mortar should then fill the spaces between the stone. The specification presupposes a void of 33⅓% in sand. My tests on

the samples of sand show the voids to be as follows (the tests were made with the material dry and shaken in such a way as to approximate the conditions of mixing and laying of the concrete):—

River sand	34·1%
Pit sand	33·7%

From this it is evident that any less than one part of cement to three parts of sand will provide insufficient

Fig. 2.—Block Cut from Pavement, Showing Segregation of Stone and Bridging Effect

cement to make a good mortar. A large percentage of the river gravel which I saw would not give any better proportion than one part cement to five parts sand, to three parts stone.

There are two methods of improving this condition:—

(*a*) By the addition of enough stone to make the proportions 1:3:5.

(*b*) By separating the gravel into sand and stone and remixing them in the proper proportions on the site of the work under construction.

Remedy (*a*) would require that almost every wagon load of material should be tested by sieving as it was laid down on the work. This would require at least the service of a competent man accustomed to such work. A great many practical considerations both from the contractor's and from the engineer's point of view, satisfy me that this would not be practicable on roadway construction in London.

Remedy (*b*) provides the safer means of surmounting the difficulty. In all kinds of government and civic concrete work the use of unscreened gravel has been as far as possible abandoned on account of the very great uncertainty of the proportions. Exceedingly few men are able to look at a sample of gravel and guess the proportions correctly, and as this generation has hung up, in a conspicuous place, the sign "Safety First," engineers generally have adopted this motto with regard to unscreened gravel.

The additional cost of separating the two materials and reproportioning will not add more than 25c. to 35c. per cubic yard to the price of the concrete, and that is a small price to pay for the safety and strength of the sub-base.

A sub-base of good concrete, with asphaltic surfacing replaced at periods of fifteen years, should last for at least seventy-five years. One other point should be mentioned in this connection and that is the increasing of the size of the loads. Motor trucks of ten-ton capacity are common, and trucks of twenty tons and over are assured for the future. It therefore becomes essential that the part of the pavement which is laid for permanency and which really carries the load should be of good material laid to get the greatest strength in the concrete.

The river sand, as separated, is clean, sharp and of good quality. It lacks the finer particles which tend to make a dense mortar. Plotting comparison of the river and pit sands with an ideal sand, it would be noted that on the finer sieve the curve of both sands comes considerably below the ideal sand. If the addition of fine sand could be accomplished without great cost, it would certainly improve the mortar.

The stone consists largely of limestone and dolomite pebbles, which are hard and clean. A small percentage (not more than 1% or 2%) of sandstone, granites and shales in a semi-decomposed state, are present in the gravel, but this percentage is not enough to affect seriously the strength of the concrete. The stone as used varies in size from ¼-inch to as large as five inches, and apparently the large stones are allowed to go into the concrete.

All the samples of concrete appear to have the required proportion of cement. It is impossible to judge the amount of cement used by inspecting the surface of the sub-base, because in a number of places rain has washed away the surface cement.

All samples of the concrete appear to be fairly well mixed. The strength of concrete depends to a large extent upon the time taken in mixing. Concrete which is mixed for ¼ of a minute has only 75% of the strength of concrete mixed two minutes. Very wet concrete mixed for ¼ of a minute has only 54% of the strength of well mixed concrete, therefore no concrete should be placed in roadways which has not been mixed one minute or more.

Fig. 3.—Fractured Surface of 6-in. Cube, Showing Effect of Segregating Coarse Aggregate

All the samples have very direct evidence of being mixed with too much water. The sub-base on Richmond Street, at the top of the grade and beyond to the end of roadway, shows this very clearly. There was also some evidence of an excess of water on Beaconsfield Avenue. Fig. No. 1 shows mortar bed of a stone taken from one

of the six-inch cubes which were tested. The notable feature of this photograph is the large percentage of void space, also the absence of any bond between the mortar and the round pebbles. Both of these conditions result from too much water.

The concrete in the sub-base on Richmond Street and Beaconsfield Avenue, has not been tamped. Instead, the concrete seems to have been mixed very wet and then raked to the grade required. The raking process accumulated the larger pebbles, which were raked to one point in the pavement. Numerous instances of this were seen. Some spaces were as great as four square feet in area. This is a serious defect in the sub-grade, as this would give a weak concrete on account of the lack of mortar. The traffic and water will soon cause a hole in pavement at these places. To plaster mortar over these spaces is not a remedy, as the new mortar unfortunately does not adhere to the old concrete.

One sample of concrete taken from the roadway showed a condition of bridging. Mortar had been raken along the sub-grade, then stones segregated on top, and then mortar placed over top of that again, as shown in Fig. 2. The result of this treatment was that between the two layers of mortar, less than 1⅓ inches in thick-

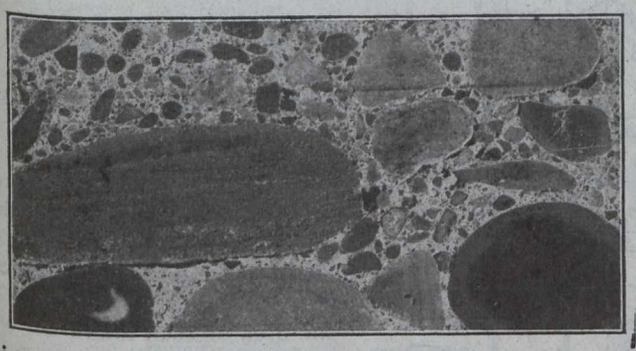


Fig. 4.—Sectional View of Sawed Block. Note Cavities Under Large Stones Due to Excess of Water

ness, there was a space without any mortar between the stones. It is impossible to go over the pavement and pick out such places, as they are hidden from view. The cause of this trouble is evidently lack of rigid inspection during the laying of the concrete. To illustrate the effect of segregating the large stones a photo (Fig. 3) was taken of the fractured surface of one of the six-inch cubes. This shows the lack of adhesion of the mortar to the stone and also why this cube withstood a lesser stress than the others tested.

The gravel, when it is delivered on the work, is dropped on the sub-grade without any effort being made to prevent the gravel and sub-grade from being mixed. With a clay sub-soil this may lead to trouble, as the sub-soil will get mixed with the concrete. From the contractor's point of view it is more economical to have his men shovel off boards than off the ground. Specifications should therefore insist upon planks being used in order to insure the concrete materials being kept clean.

It is therefore recommended:—

1. On account of the uncertainty which exists between the sand and stone proportions, it becomes of prime importance that the sand and stone should be separated by screening. But before the material is screened, it should also be run through a crusher, set for 2-inch material. The crushing reduces the stone to uniform grade, and eliminates the large stones, which gives the best concrete stone. It also adds crusher dust from the broken stone and pulverizes some of the sand particles to supply the finer material necessary to the sand; and it tends to complete the breaking up of the sandstone, shale and granite pebbles which are in a semi-decomposed state. The screening should be done without water if possible, as the water would tend to take out the fine material that it is advisable to retain.

2. The concrete should be mixed for at least one minute, such time to be taken as the time that concrete is actually in the mixer.

3. Only enough water should be added to give a concrete which is clammy and on no account should concrete be used which will flow in the spout when the spout is inclined at less than 60 degrees to the horizontal.

4. It is necessary that all concrete should be thoroughly tamped, as the tamping helps to work out any excess water and improves the density and strength of the concrete. Tamping will also help to eliminate the bridging.

5. The specifications in use should be rewritten to incorporate the changes recommended, and all indefinite phrases such as "properly protected" and "proper intervals" should be given a definite meaning, explicitly stating the degree of protection required and the intervals at which the pavement should be sprinkled. Every indefinite point in a specification means that it becomes increasingly difficult for an inspector to enforce such clauses.

6. Nearly all of the defects which have been mentioned in the pavement could have been avoided by rigid inspection during the laying of the concrete. The excess of water, the mixing, the segregation of the stone and the tamping are all defects that a good inspector would never have permitted. The recommendation is made, therefore, that the inspection of all concrete pavements should be systematized and made rigid.

7. Every carload of cement should be tested and considered as a unit; it is no hardship to ask a contractor on a piece of work like the Richmond Street pavement to provide his cement in carload lots so that it may be tested. The sand also should be tested regularly, and a record kept of all such tests. Test blocks could be made up from each day's mixing and kept as a part of the progress record. These could be stored and tested and if trouble were to occur, they might prove very valuable, or if a daily check on the concrete were desired, they could be tested at the end of seven days.

8. All material should be dumped on planks and kept securely separated from the sub-grade soil.

9. The materials used should be accurately proportioned by measuring, either in a box or a wheelbarrow.

The following six railroad lines are under course of construction in Argentina: Pichinal to Oran, Province of Salta, 17.4 miles; Nare to San Javier, Province of Santa Fe, 45 miles; Catamarca to Tucuman, 115 miles; Talapampa to Alemania, Province of Salta, 6.8 miles; Metan (Province of Salta) to the east, 150 miles; and Milagro (La Rioja) to Quines (San Luis), 85.6 miles.

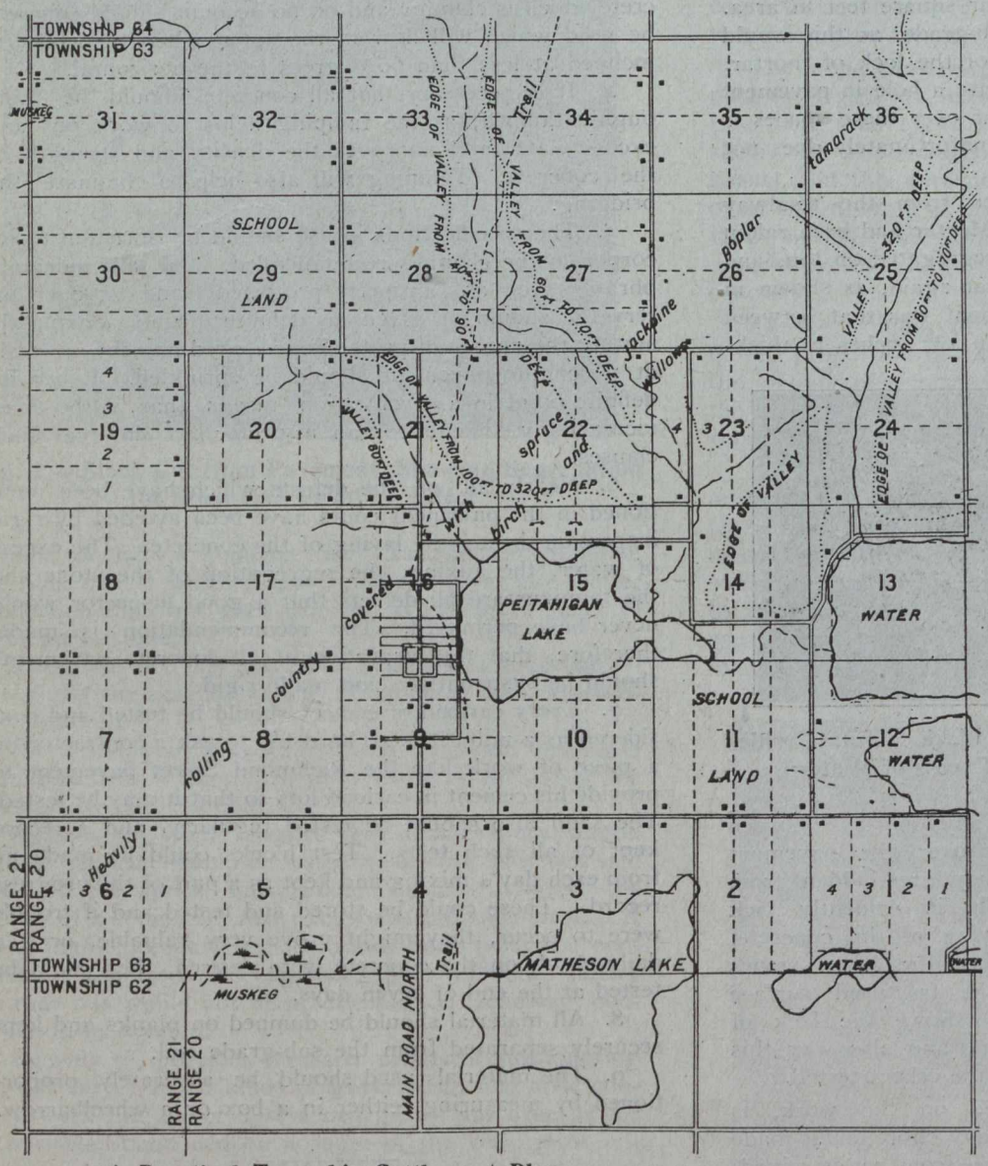
A company has recently been formed in New Zealand, with a capital of $340,000, with the object of producing iron and steel from magnetic and titaniferous iron sand, of which there is a large deposit on the coast at Taranaki, near New Plymouth, where the works are to be erected. The initial plant will be capable of dealing with 70 tons of iron sand weekly, but plans have been drawn up for the installation at a later date of an additional furnace capable of dealing with 200 tons weekly. The production of steel is also contemplated, and it is intended later to form a new company to carry out this development.

A PRACTICAL TOWNSHIP SETTLEMENT PLAN*

By W. A. Begg, D.L.S., S.L.S.

THE essential features of any improved plan to further land settlement in the northern parts of the provinces of Alberta, Saskatchewan and Manitoba must be: (1) Suitability of the shape and size of the lots and suitability of the road system to a topography described as rolling land, heavily wooded and broken with lakes, marshes and streams; (2) adaptability to the existing systems of survey and methods of indexing and describing land; (3) establishment of a community or settlement centre whereby the man with a trade or business, upon which the homesteaders are dependent, might secure sufficient land and an opportunity to practice his trade concurrently with the settlement of the township.

The diagram has been prepared to illustrate the proposed scheme. It contains the above essentials, in a degree, at least, more perfectly than the present system, in which the first and last are all but absent, and more perfectly than certain plans, which have appeared in the public press deriding the second essential and going from simplicity to the other extreme. It is proposed to show that the scheme could be applied to any township plan in the third or fourth system of survey for Dominion lands which is now surveyed but not yet entered upon for settlement, and within a month or so a new township plan in accordance with the scheme could be placed in the Dominion Lands Office with a minimum disturbance of the present methods of making entry and keeping records.



A Practical Township Settlement Plan

Adapted to the Topography of Township 63, Range 20, West of the Third Meridian, Sask. Scale, 100 chains to an inch.

Two chief and radical changes are proposed, namely, (1) Where not inconsistent with the topography, the lots for agricultural purposes will be normally 80 chains by 20 chains and may be laid out fronting either north, south, east or west, depending on the road system; (2) the roads will not be laid out according to a set system but will be located by an engineer after the survey by the Topographical Surveys Branch and after a thorough and personal investigation of the topography. This implies that the road allowances, now reserved from the sections, will be included within the area of the lots or quarter sections, and a general reservation of 3 per cent. of the area of each allotment will be reserved from the patent for road purposes.

It is not the writer's intention to reproduce the many arguments already advanced by many able men in favor of a changed system. Favorable opinion has been aroused. It is felt rather that an explanation of a method of arriving at the desired result might remove the apprehension and attitude of doubt with which any changes affecting land settlement is viewed.

Preliminary Investigation

The Dominion land surveyor, during the progress of a township survey, makes careful note of all the topography encountered on the surveyed lines, but only when large lakes or rivers are to be traversed does he map the physical features within the interior of any section. Notwithstanding, a map prepared from the surveyor's field notes could show much more information concerning the topography than is now shown upon the authorized township plan. The first step after the survey of the township would be the preparation of a plan showing the topography as fully as possible.

It is proposed that an engineer, experienced in road location, should make a two or three weeks' investigation

*From "Conservation of Life."

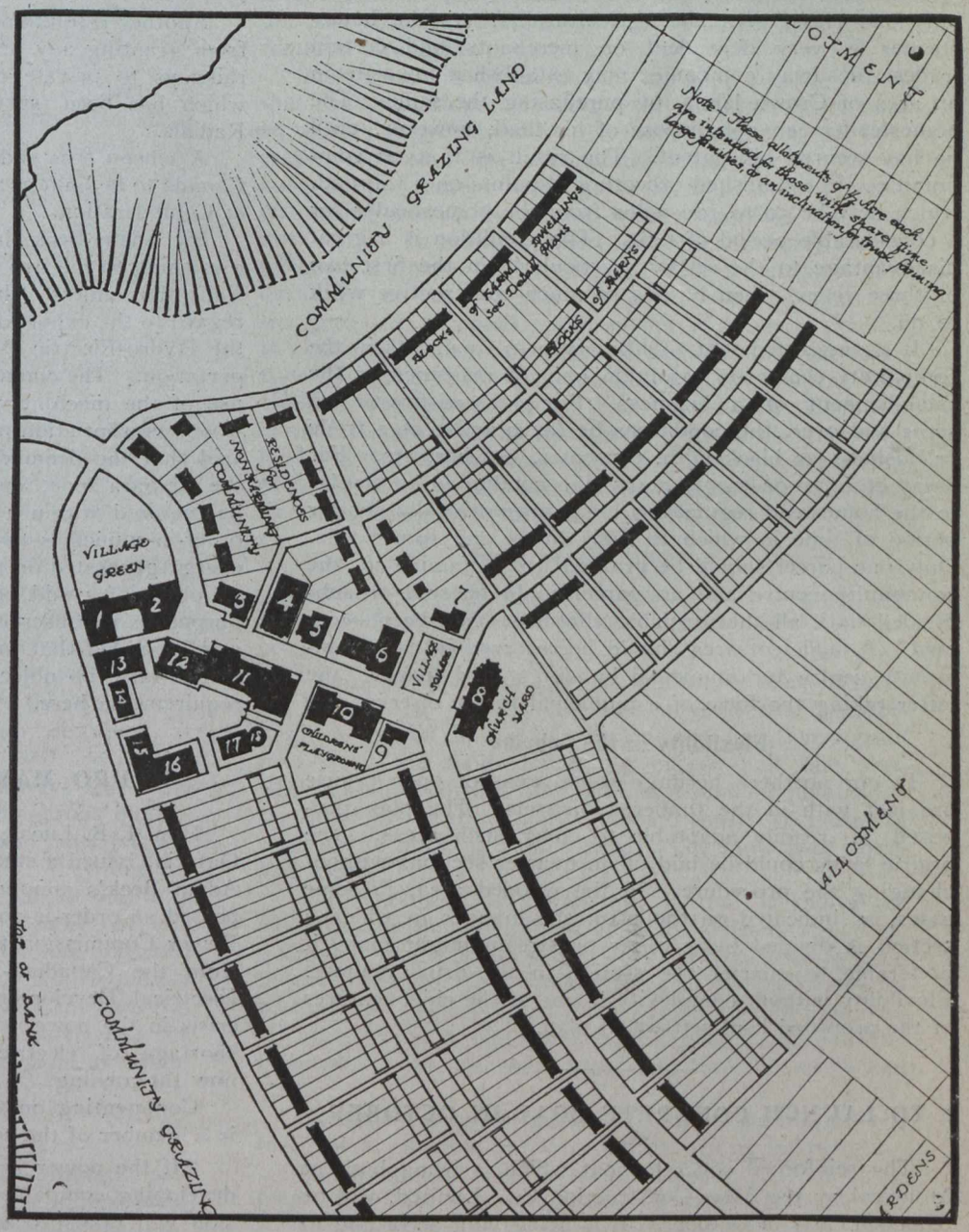
in the township. He would require a topographical map, barometer and prismatic compass, and such assistants and transport as would enable him to move rapidly about in unsettled districts. The first duty of the engineer would be to make himself fully acquainted with the main topographical features. It would be necessary to be fully informed also with regard to the conditions in the townships immediately adjoining, the nearest improved roads and main trails. He would then be in a position to prepare a draft plan of the settlement.

Plan of Settlement

The selection of a suitable site for a community centre would be the first step. The requisites of the location would be dry ground, a satisfactory water supply and a central position on two or more main routes through the township. The engineer would then locate on the plan the approximate positions of the main roads and a sufficient number of laterals to provide access to every lot. By examining the plan accompanying the text it will be noticed that, in order to devise a suitable road system, it will be necessary to depart from the lot boundaries in some instances. It will be possible, however, by having four lots rather than quarter sections, to have more choice in the location of the roads without dividing any lot.

The division of the sections into lots or quarters will require to be considered in connection with the location of the main roads and laterals. It will be possible, as is shown upon the plan, to divide the sections so as to place the wet or broken land at the rear of the lots, and have as many as eight homesteads fronting on one mile of road.

Taking into consideration economy in road construction, safety from fire in having continuous clearings and the possible improvement in social life, it must be admitted that the foregoing has great advantages over the present system. The possible reduction in road mileage would be about one-third of the mileage of the road allowances in the townships under the third system of survey.



Plan of a Village Community Centre by H. B. and L. A. Dunnington-Grubb

REFERENCE:—1, Concert hall; 2, young men's club; 3, bank; 4, moving picture theatre; 5, inn; 6, town hall; 7, vicarage; 8, church; 9, teacher's residence; 10, school; 11, department store; 12, post office; 13, creamery; 14, bakery; 15, blacksmith and carpenter shop; 16, garage; 17, granary and storage; 18, elevator and chopping mill; 19, saw and rossing mill; 20, central heating plant; 21, greenhouse.

After preparing the draft plan of the roads and lots, the engineer would probably require to make further detailed examinations of the proposed road locations and make revisions. Before leaving the ground, however, his plan should be complete. It would not be necessary for him to actually survey and post the roads and lot boundaries. He would probably show certain locations, knowing that the direct line could not be followed and that a winding side-hill road would be required. The survey of these roads and the lot corners could be proceeded with at a later date when settlement had proceeded and the construction of the road had become necessary. The present system requires the survey of a large number of new roads and diversions from the road allowances on account of the useless location of the latter. The scheme of prior investigation before establishing the location would obviate the need of very many road surveys.

The act of recording the plan prepared by the engineer could be made to automatically reserve the approximate area of the proposed roads from the lots affected, and define the same as public roads. The title to the road could be transferred to the Crown in the right of the province when the position of the road had been definitely decided upon by the municipal authorities.

Where such a plan was based on the third system of survey, it would be found that the lot areas would be normally 160 acres, but that a few lots would contain 165, 164 or 161 acres, according to location. This inequality might be disposed of by charging a nominal sum for any acreage over 160 acres at the time of securing the patent.

The Community Centre

The present system of land settlement provides for only one class, *viz.*, the agriculturalist, yet the homesteader is very dependent on merchants and certain trades. Railway companies may establish a townsite in an area of Crown lands, by purchasing the same. The homesteader can not dispose of his land, however, until he has secured his patent. The result is that no communities are established excepting at points on a railroad, which may be 50 to 100 miles from the homesteader for a considerable period of time. This condition is a great disadvantage to the settler, particularly in the first two or three years, when he has so much constructive work to do.

It is suggested that title be given to small lots in the community centre on condition only of residence or the establishment of a business. For areas of five or ten acres and over, the conditions be the practise of a trade or business as blacksmith, carpenter, butcher, etc. For areas of forty or eighty acres, the conditions be similar to the homestead regulations but a proportionally shorter period of time in which to fulfil duties and secure title. Only one parcel should be granted to a family in the community centre and no parcel could be sold or subdivided until all the available allotments had been occupied. A sufficient area should be reserved in each community centre for municipal buildings and parks, the latter taking the form of a municipal forest reserve.

Flexibility of the Scheme

In our northern heritage some areas of open prairie are met with in the timbered districts. The plan proposed is readily adaptable to cover such areas. The prairie lands could be laid off in quarter sections without changing the procedure. In the wooded area, in some cases, as indicated on the plan, the manner in which a section is divided by a valley or stream might make it preferable to quarter the section in the usual manner. Flexibility without complexity is one of the chief features of the proposed land settlement plan.

TO LAUNCH CONCRETE BOAT IN OCTOBER

The reinforced concrete boat which is being built at Montreal by the Atlas Construction Co., Limited, will be launched early in October. It is being built according to plans prepared by Prof. Ernest Brown, of McGill University, and Michael Morssen, president of the Atlas Construction Co. This boat has been financed by a syndicate of prominent Montreal business men, the Atlas Construction Co. having been the prime movers. The cost of the boat will be upwards of $100,000.

The Committee on Car Service of the Advisory Commission of the Council of National Defence in the United States has recommended the Government purchase of 100,000 gondola cars and 50,000 box cars. The Executive Committee, whilst welcoming the suggestion, has pointed out that additional power and terminals would be more effective, and that the railways have 100,000 cars stilll undelivered on order from the manufacturers.

UNION OF CANADIAN MUNICIPALITIES

During the annual convention of the Union of Canadian Municipalities, held in London, Ont., last week, a resolution was adopted urging the Dominion Government to take over the Grand Trunk Railway and Grand Trunk Pacific as well as the Canadian Northern. Sir Adam Beck, in an address, advocated this resolution and his proposals were reviewed very favorably by the convention.

Another resolution requests the government to refrain from granting any new charters or extensions for radial railways to private companies, particularly in territory which has been surveyed for Ontario Hydro-Electric Radials.

A scheme was endorsed for a national highway across Canada to be built as a memorial of the fiftieth anniversary of Confederation.

Sir Adam Beck, in addressing the convention, issued a warning to the two private power companies at Niagara Falls that unless "they deal fairly with the people" in regard to the export of 115,000 h.p. to the American side, the Hydro-Electric Power Commission will end such exportation. The commission, he said, is prepared to make use of the machinery provided by the legislature under which expropriation proceedings may be undertaken. He said that the demand for power is rapidly increasing in the Niagara zone, and that an additional 83,000 h.p. will be required within a short time. He intimated that an order-in-council is now pending to expropriate all of the energy generated on the Canadian side. He declared that no objection could be raised to such action when the purpose is to conserve the power for the people of Canada, and he added that public opinion in the United States would raise no objection in view of the urgency of the requirements here.

HYDRO MAY EXPROPRIATE POWER

Hon. I. B. Lucas, Attorney-General of the Province of Ontario, issued a statement last week which confirms Sir Adam Beck's announcement that the government has passed an order-in-council authorizing the Hydro-Electric Power Commission to expropriate power, if necessary, from the Canadian-Niagara Power Company and the Electrical Development Company in order to prevent a crisis in the power situation in Ontario, where a serious shortage of electrical energy for industrial purposes is now threatening.

Commenting on the situation, Hon. Mr. Lucas, who is a member of the commission, said:—

"If the power is not secured by agreement from the developing companies, I assume in the end the commission will take proceedings to expropriate the power required from these companies under the Public Works Act."

Under expropriation proceedings the commission would, after taking the power, apply to the courts for an arbitration board to fix the price to be paid.

In a later statement, Hon. Mr. Lucas expressed the hope that the International Waterways Treaty between Great Britain and Canada could be amended so as to allow Canada to divert more than 36,000 sec.-ft. from Niagara Falls. An increase in the amount of water that can be used, he said, would naturally solve the problem of power shortage in Ontario and make the expropriation of power unnecessary. He stated that expropriation would be a matter to be approached very delicately.

SANDS AND CONSISTENCY OF CONCRETE

By L. N. Edwards,
Supervising Engineer of Bridges, Toronto

(Continued from last week's issue.)

THE first batch of concrete used in the tests was mixed on March 30th, the last batch on July 25th. The range of temperature and humidity was therefore comparable with that usually found in northern latitudes in a working season extending from April 1st to October 20th. In this connection, however, it must be borne in mind that the actual mixing of the concrete was done between 7 and 8.30 a.m. The proportioning, mixing, and placing was doubtless more accurately, uniformly, and carefully done than is usual upon high-grade construction work. The conditions of seasoning were as nearly uniform as could be provided at a nominal expense. All testing of materials, cylinders, beams, etc., was done by experienced operators. It is therefore reasonable to assume that irregularities due to the methods of procedure are comparatively small, and that the results obtained are generally normal.

In actual concrete construction operations in the field, the object sought, in so far as the specifications for any particular structure are concerned, is, without exception, to produce a good, reliable material. Results frequently fall short, however, for due to a misleading popular opinion that "anyone can build in concrete," comparatively few field superintendents and foremen have developed a thorough knowledge of concrete materials and of high-class field methods. The hazardous policy of "save the labor and spoil the concrete" is too frequently found in a sort of inseparable combination with the above.

As a result of the conditions already described, it occasionally happens that the materials used are not always of good quality, neither are they always free from admixture with harmful ingredients in dangerous quantities. In the transitory stage the component materials are frequently used in improper proportions; they are insufficiently mixed; the cementing material is not fully developed; and the mass is subjected to more or less abuse, with the eventual result that the concrete produced contains myriads of voids and cavities, and frequently lacks strength, hardness, toughness, and the general durability requisite for good construction material of the class contemplated by modern practice in plain and reinforced-concrete design.

Strength Requirements

As a basis for comparisons assume the ultimate compressive strength of concrete in pounds per square inch, when tested on 6 by 12-in. cylinders, to be as follows:—

Age of 1 month, 1:2:4 mix, 2,200 lbs. per sq. in.; 1:2½:5 mix, 1,900 lbs. per sq. in.

Age of 3 months, 1:2:4 mix, 2,800 lbs. per sq. in.; 1:2½:5 mix, 2,300 lbs. per sq. in.

Assume also the conditions of mixing, placing, storage, etc., to be the same as existed in the tests already described.

By reference to Figs. 8 and 9, it appears that of the weaker sands Nos. 9, 10, 11 and 12, only sand No. 9 would be acceptable for a 1:2:4 mix, and sands Nos. 9 and 10 for a 1:2½:5 mix. The stronger sands, Nos. 2, 3, 6 and 7, would give an excess strength of from 25 to 51 per cent. for a 1:2:4 mix, and from 36 to 49 per cent. for a 1:2½:5 mix.

Using relative strengths, as shown in Fig. 13 for a third consistency of mix, all sands used in the tests would fail to fulfil the 1-month age requirements. At the age of 3 months, sands Nos. 2, 3 and 6 would give an excess strength of from 1.5 to 16 per cent. for a 1:2:4 mix; while sands Nos. 2, 3, 6 and 7 would give an excess strength of from 6 to 15 per cent. above that required for a 1:2½:5 mix. Similarly for a fifth consistency of mix, the weaker sands would give approximately 40 to 60 per cent. and the stronger sands 65 to 85 per cent. of the required strengths.

The results as given under "time of mixing" show that the conditions attending field mixing may be such as to very materially affect the final strength of the concrete produced. The detrimental influences of one or more of the factors investigated in this series of tests frequently exist in connection with actual field construction work. In addition, there are other harmful factors which to a greater or less degree affect the strength and durability of the concrete produced. To the contrary, the generally accepted requirements of modern practice in plain and reinforced-concrete design assumes the existence of good materials, and the use of efficient field methods and operations in their application. Economy of construction requires that the practice of design be upheld. Safety and permanence demand greater knowledge of concrete materials, and greater efficiency in construction methods and operations.

Sand Specifications

As early as 1855 Mr. T. Hughes, Civil Engineer, in a series of papers described his choice of sand for concrete work as follows:—

"To speak practically of the mixture of sand in making concrete we should say that none of the particles ought to exceed the size of a barley-corn, and that a great portion of the sand should not exceed half that size, while another portion of the sand, equal in quantity to the other two portions united, should consist of grains of sand not so large as a pin's head. The sand to be sharp and clean."

This quotation is interesting, in that it shows the valuable information gained by early artisans and engineers in concrete construction work, to have been ignored by the writers of sand specifications in comparatively recent years. It is only within the past decade that American concrete specifications have provided requirements other than that the sand aggregate shall be sharp and clean.

The author submits specifications for a sand to be used for general concrete purposes, which are as follows:—

Sand shall be of hard, preferably silicious, material, clean, rough, free from dust, soft particles, vegetable loam or other deleterious matter. It shall consist of particles graded from coarse to fine, of sizes that will pass, when dry, a sieve having 4 meshes per linear inch. The grading of particles shall otherwise conform to the following:—

Not more than 80 per cent. shall pass a sieve having 10 meshes per linear inch, not more than 55 per cent. shall pass a sieve having 20 meshes per linear inch, not more than 15 per cent. shall pass a sieve having 50 meshes per linear inch, and not more than 5 per cent. shall pass a sieve having 100 meshes per linear inch. Upon the 10, 20 and 50-mesh sieves an allowable variation of 5 per cent. will be permitted.

Sand, when combined with a normal Portland cement and 1-in. broken granite, limestone or trap of good quality in the proportions 10 lb. of cement, 21 lb. of dry sand, and 35 lb. of dry broken stone, thoroughly mixed with 4¼ lb. of water for not less than 1 minute and moulded into cylinders 6 in. in diameter by 12 in. long, shall develop a compressive strength of 1,300 lb. per sq. in. when tested at the age of 7 days and a strength of 2,200 lb. per sq. in. at the age of 30 days. Strength

shall be determined from an average of five cylinders tested at each age. The cylinders shall be removed from the forms 24 hours after moulding and shall be stored in a moist closet or in damp sand until tested.

Sand failing to develop the above strengths may, at the option of the Engineer, be accepted for use, provided that the proportion of cement be increased by an amount sufficient to fulfil the strength test requirements.

It is believed that these specifications are adapted to the determination of a satisfactory sand aggregate for general concrete work. Whenever the conditions involved require the use of concrete having special density, toughness, or other physical properties, the fitness of a given sand should be determined by special test.

The specifications assume that provision is made for the proper proportioning of the cement content of the mix, in cases where sands failing to meet the strength requirements are used. It also assumes that proper provision is made for the limiting of the water content of the mix to that required to produce a saturated, sticky, semi-plastic mortar.

It will be noted that the time limits provided for in the specifications are nominally the same as those provided for in the testing of cement.

Conclusions

The description of methods used and of results obtained have been given sufficiently in detail to permit the reader to modify and correct the conclusions of the author, accordingly as his greater experience or better judgment dictates. However, from a careful consideration of the results obtained and of the phenomena observed, the following conclusions appear to be warranted:

1. The commonly practiced "visual examination" test of sand aggregate for concrete is generally unreliable, since it gives at best only a superficial knowledge of the cleanliness of a given sand. Its adaptation to the determination of grading could be of value to the observer only after long experience in the granulometric analysis of sands.

2. The generally accepted practice of proportioning a concrete mix by volume, as, for example, 1 part cement, 2 parts sand and 4 parts broken stone, is impracticable and unscientific, since it does not take into account the adaptability of the grading of a given sand to the production of a dense, strong, and reliable concrete. Proportioning by volume, as commonly used, gives no guarantee of the production of a concrete having a desired strength, hardness, or other physical properties.

3. The strength, toughness, and durability of the concrete to be secured from the use of a given sand can be determined only by an actual test of that sand in a properly prepared concrete.

4. In field operations incident to spading, slicing, or otherwise compacting the concrete, the movement of the water content of the mass is intensified, whenever the sand aggregate contains insufficient fine material to hold the cement in suspension by the formation of an adequate amount of sandy paste. The free movement of the water tends to produce an improper distribution of the cement.

5. The use of a quantity of water sufficient to produce a concrete, the mortar component of which is of a saturated, sticky, semi-plastic consistency, is for most practical purposes required, in order to facilitate economical and efficient placing. This quantity of water is ample for the development of the proper functions of the cement. An increase in the quantity of water used results in a proportionate decrease in the strength of the concrete. This decrease is in no sense a function of the proportions of the mix.

6. The excess water in an over-saturated concrete necessarily occupies space and thereby bulks-up the mass. By reason of its high surface tension, it forms water globules which, although somewhat affected by the weight of the concrete, are nevertheless distributed throughout the mortar component and are accumulated underneath the particles of the sand and stone aggregates and the reinforcing steel. By evaporation, this excess water ultimately disappears, leaving a considerable volume of water voids and cavities which constitute an extremely important factor in the strength and reliability of the concrete.

7. The critical failure of reinforced concrete depends upon the intensity of the bond existing between the concrete and the steel reinforcement. Concrete containing an excess of water not only develops less surface contact with the steel on account of the resulting increase in the volume of water voids and cavities; but, in addition, the excessive laitance produced by the water tends to accumulate around the reinforcement, thus contributing materially to a decrease in strength. This condition becomes further aggravated by reason of the tendency of the laitance to become less resistant with age.

8. For the various grades of concrete, the minimum ultimate strengths assumed in the modern practice of plain and reinforced-concrete design are not assured by the commonly specified requirements for sand and stone aggregates, and by the present lack of uniformity and of efficiency in field methods and operations.

9. The results obtained show no definite relation between the compressive strengths of 1:3 mortar cubes, and the compressive strengths of the concretes produced from the same sands.

Acknowledgments.—The author takes sincere pleasure in here giving due credit to those who have rendered worthy assistance in various portions of the work, in the making of test specimens, chemical and physical tests, and tabulation of data.

Special mention is due C. Dennis, A. S. Goss, R. G. Goss, W. O. Hutchins, F. G. Marriott, R. J. Marshall, C. J. Townsend and M. Walsh.

The output of aluminium from the works at Foyers and Kinlochleven, in Scotland, is said to be well over 10,000 tons per year.

Bill No. 125, entitled, "An Act Providing for the Acquisition by His Majesty of the Capital Stock of the Canadian Northern Railway Co.," follows almost exactly the wording of the resolution upon which the act was based. This resolution was printed on page 109 of the August 9th issue of *The Canadian Engineer*. But few changes have been made in the resolution when put into the form of the bill and these are of a very minor character, chiefly grammatical, and do not change the method of acquiring the stock in any way whatever.

A canvass of the principal shipyards in the United States made on May 1st, showed that 2,250,000 tons of merchant ships were under construction, 52.5 per cent. being built on the Atlantic and Gulf coasts, 33.2 per cent. on the Pacific coast, and 14.3 per cent. on the Great Lakes. The report comprised returns from 96 shipyards. In all, 723 merchant vessels were under construction. Three hundred and nineteen of these vessels, aggregating 1,539,354 gross tons, are freight steamships or motorships, 77 vessels of 365,488 gross tons are tankers, 10 vessels of 55,260 gross tons are passenger and freight steamers, and 118 vessels of 159,663 gross tons are wooden ships, either schooners or auxiliary schooners, while the remainder, or 199 vessels of 128,435 gross tons, are miscellaneous craft, such as barges, lighters, ferryboats, etc.

DESIGN AND CONSTRUCTIONAL FEATURES OF TURBINE PUMPS

By A. E. L. Chorlton

(Continued from last week's issue.)

AS is well known, the internal design of a multi-stage turbine-pump involves a rotor comprising a number of impellers keyed on to a shaft, the shoulders or bosses of which abut on each other and are secured and maintained together by double nuts or the like at, or near, the ends of the shaft. Such portions of the shaft as are not covered by the impellers, but are subject to the action of the pumped liquid, are protected by sleeves which fit up to the impeller bosses and thus make a complete sheath outside the shaft itself, Fig. 1 (b), and Fig. 2 (a and b), etc.

This rotor revolves within the guide-chamber and housing, each impeller running at some points in the closest proximity to the partitions dividing the pressure-stages and return-guides.

These so-called running joints or neck-rings must be so maintained by design and construction as to secure in continued service the smallest possible hydraulic leakage-back from stage to stage, or mechanical loss by rubbing friction, both of which affect the efficiency and wear and tear of the pump. As a question of practical importance, the design of this combination probably follows next to that of the successful automatic hydraulic balancing of the axial end-thrust. We have in it the question of the deflection of the pump-shaft; the reinforcing effect of the surrounding impellers; the support afforded by the bushes, if any, between each stage, and the loss by bush friction (wear); the form of neck ring to reduce leakage; and the effect of keyways and keys, etc., all independent of each other and affecting the whole.

The ideal condition is that of a rotor supported in lubricated bearings with a shaft of such sufficient stiffness between supports that the deflection, under all possible running conditions, is less than the clearance allowed at the neck rings and intermediate bushes, so that no contact takes place between the rotating and the fixed members, this clearance at the neck-rings and intermediate bushes being kept down to the smallest possible limit. It will be seen that it is impossible to present mathematically, the exact conditions with such a number of incalculable factors to take into account.

For instance, it may be thought that a not inconsiderable reinforcing effect is obtained by the combination of the impellers outside the shaft as a whole. In practice, however, it is not advisable to lock up the impellers together shoulder to shoulder against each other by the end-nuts in order to get the advantage of the reinforcing effect; because, due to amongst other things, the slight inaccuracies of manufacture in squaring the shoulders of the impellers, sleeves, etc., the result would be to throw the combination out of truth, that is, to distort the shaft.

It might be contended that this need not be so, but even then provision must be made for dismantling in a mine or similar place, with its obvious attendant disadvantages, and the possibility of rough treatment taking place; furthermore, as a safeguard against heating up and consequent expansion of the outside combination (bronze) against the internal (steel) shaft due to accidental contact with the intermediate bushes, running, perhaps, when the pump is empty, suitable expansion should be allowed for, and the impellers, to ensure this, must not be locked tight against each other.

The supporting effect of the bushes on the shaft, in passing through the diaphragm intermediate between the impellers, is very difficult to exactly allow for; it may be that the bushes will decrease the deflection of the shaft by a material amount, but it must not be assumed for one moment that they are bearings of such a nature as lubricated bearings. Intermediate bushes can only, in some cases, be considered as water-lubricated supports which will act as such so long as a certain low surface pressure on them is not exceeded; if too great pressure comes on, heating takes place on account of the high speed of rotation. The effect of wear has also to be taken into account for the hydraulic pressures at the two ends of these bushes are different and there is, therefore, always a flow taking place through them, carrying with it any sedimentary or foreign cutting matter which may be in the water. This state of things causes the supports to wear more or less rapidly so as to become almost useless, the pump eventually arriving at a condition worse than if a suitable clearance had been allowed at the first.

The author believes that too much use is made of these intermediate supports in turbine-pump design. It was found in practice that an internal bearing to be successful must have the same water pressure at both ends, and must be properly lubricated with good grease, it then gives excellent results. We are thus left with the fact that we are practically dependent on the shaft itself for the necessary strength and stiffness to allow of fine internal clearance, and the importance of a good design which will economically give the minimum deflection of

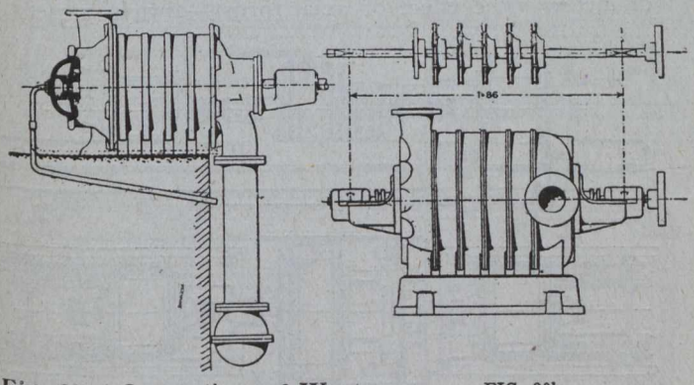


Fig. 29.—Connections of Waste Water from Balancer

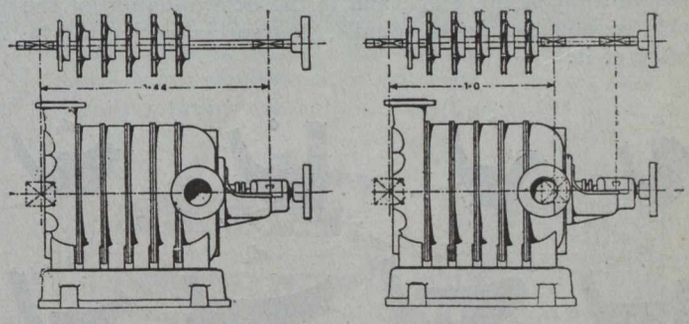


FIG. 30b. FIG. 30a. FIG. 30c.

Fig. 30.—Span of Bearings—Three Arrangements

spindle at once becomes apparent. The factors affecting the deflection of a turbine-pump spindle are:—

Static

(a)—The weight of spindle and distribution of diameter change;

(b)—The weight and distribution of impellers, balancer, and parts;

(c)—The number and span of supporting bearings; and

Dynamic

(d)—In the dynamic condition, other incalculable forces entering into the account, such as, centrifugal forces due to the out-of-balance masses, and finally certain hydraulic disturbances.

(a)—Should be as light as possible consistent with the necessary stiffness; in common practice spindles are practically parallel the whole length.

(b)—Impellers and balancer should be grouped together as closely as possible, only allowing sufficient space for the water passages between the stages; also, the entire weight should be brought as close to the supporting bearings as possible.

(c)—The span of supporting bearings plays such an extremely important part in the durability of the pump; in the possibility and preservation of fine clearances; in the whirling of the shaft, and in the determination of the most economical size of spindle, that special notice will be taken of it.

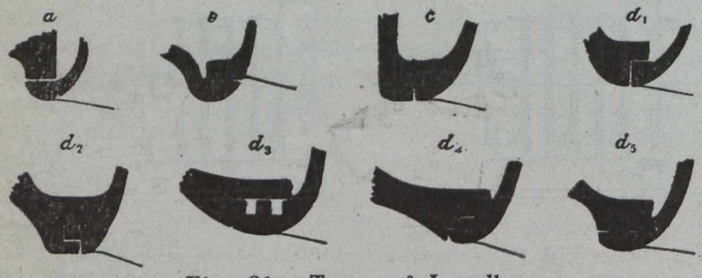


Fig. 31.—Types of Impellers

(d)—A loaded shaft supported horizontally between two bearings will "sag," and when rotated must suffer bending at every revolution. Also, there are bound to be certain out-of-balance masses in the rotor due to keys, heterogeneous composition of material, and the unavoidable variation in thickness of castings, etc. In addition, a shaft has vibrational periods due to its length and diameter, the whole question of vibration being intensely complicated by the loading and supports.

In addition to the disturbing factors mentioned above, vibrations are set up from the reaction of the impeller vane passing the guide vane. It is usual to reduce the intensity of this disturbance by arranging an odd number of vanes in the impeller relative to the guide vane, and by setting successive impellers on the shaft in such a way that the point of passing-vanes is progressive throughout the series, i.e., a "lead" is given. The resultant of these arrangements is to produce a vibrating influence, which may be torsional or combined torsional and transverse, of very high frequency and enfeebled intensity and which, when properly carried out, is free from practical disadvantage. The damping effect of the water film in neck bushes is appreciable in overcoming slight vibrations, as is conclusively shown by the different behavior of a spindle when running a pump dry and when running it filled with water. In order for a shaft to oscillate, it must force liquid out of one side of a neck-ring, and the retardation offered by this action has a noticeable effect. For this reason, quite apart from the lubricating effect gained, it is always a wise precaution to fill a pump with water before running it, otherwise if the shaft is not a stiff one seizing-up will probably occur. The remedy for spindle vibration due to any cause whatever is always a stiff shaft.

The whole matter of whirling shafts has been examined by several investigators, prominent among whom is Professor Dunkerley, but it is not proposed to discuss the matter further than to refer to the general proportions affecting the critical speeding of whirling. We find that the length (l) of span of bearings, and the diameter (d) of the spindle have an effect varying as:—

$$\frac{d^4}{l^3}$$

Turbine-pumps do not usually run at speeds approaching the critical speed, but the maximum safe speed for any rotor will bear a direct relation to the critical speed, in the sense that it will be an equal factor for equal safety. The above relation shows then, that for a fixed critical speed a reduction in the span of the bearings results in a material reduction in the necessary shaft diameter. The effect of axial thrust—always present in

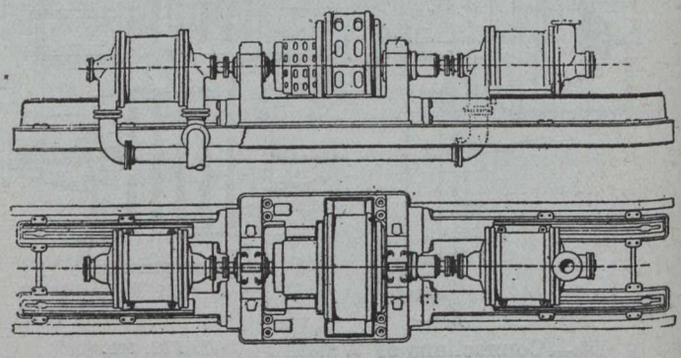


Fig. 32.—Bed for "Cylindrical" Type of Casing

a turbine-pump—in lowering the critical speed of a spindle should always be borne in mind. With a view to considering the effect of the spindle diameter and span of bearings on the degree of fineness of the running clearances, we will examine the extent of the deflections. The following arrangements of bearings are possible and are illustrated in Fig. 30:—

1.—Two outside bearings.

2.—One outside and one inside bearing.

3.—One outside and two inside bearings.

A typical example was taken, and it was found, after drawing out the different arrangements, that the ratios of the spans of the bearings supporting the loaded shaft were, for the three cases, 1.86, 1.44, and 1 respectively, calling the shortest span unity.

As the deflection of a circular spindle is proportional to $\frac{l_3}{d^4}$, the deflections themselves for the above spans are proportional to 6.5, 3, and 1 respectively, or, the necessary sizes of spindles to maintain the same deflections are proportional to 1.6, 1.3, and 1. These results are conveniently tabulated:—

Case.	Ratio of span.	Ratio of deflections.	Ratio of spindle diameter to preserve constant deflection.
1. Two outside bearings. Fig. 30a	1.86	6.5	1.6
2. One outside and one inside bearing. Fig. 30b	1.44	3	1.3
3. Two inside bearings. Fig. 30c	1	1	1

It will be noted that no allowance has been made for the buoyancy of the medium (water) in which the rotor revolves. The great importance of keeping the distance between bearings in a multi-stage turbine-pump as short as possible is abundantly clear from the foregoing, for with the more or less customary type, Case 1, Fig. 30a, with outside bearings at each end, it is seen we have a deflection of six and a half times that of a pump with two internal bearings. The direct result of this extra deflection is that the clearances between the outside of the eye of the impellers and the neck-ring must be increased to allow of the impellers revolving without touching, and this increased clearance necessarily means a correspondingly increased leakage and loss of efficiency.

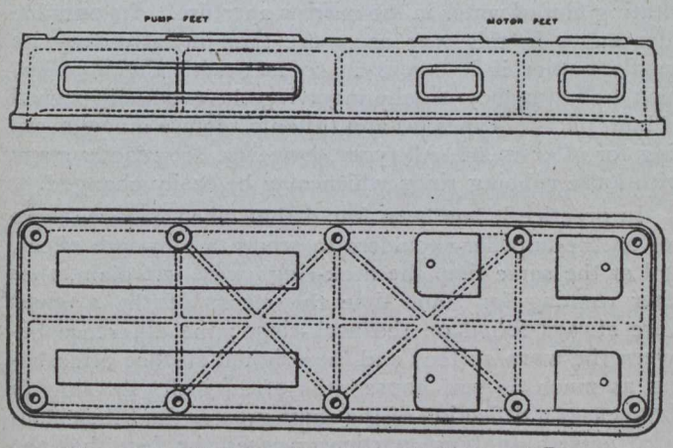


Fig. 33.—Bedplate for "Ring" Type of Pump

Further, as has been shown, the passage of a large volume of water through the running clearance means increased wear and a tendency to push the walls apart, and therefore force the impeller and shaft still farther out of the straight with consequent friction against the adjacent neck-ring surface. Dynamic out-of-balance may, and, very probably, will exist, even though considerable care has been taken in the workshop to overcome it; this factor is a very important consideration, and calls for a very stiff shaft to resist its possible occurrence, because, if the shaft and impellers are thrown out due to this, then further clearance at the neck-rings is necessary or abrasion will result. The question of the reactive effect of an impeller discharging unequally round its circumference is capable of so many variations that the only practical way to overcome this also, is a mechanical construction that will resist deflection, that is, a stiff shaft.

There is a further disturbing influence which is more active in smaller pumps, namely, the effect of the hand-packed and often ill-adjusted stuffing-box and gland; this detail is always standard for one end of the pump, and sometimes found at both suction and delivery ends. Apart from the cutting effect of such a packing on the shaft or its sleeve, it also, by reason of its compression in screwing up, tends to set the shaft out of the true centre, and so may intensify many other similar influences. The risk of outside bearings, separate or overhung, being slightly out of centre, must also not be forgotten. For very many reasons, therefore, it is extremely important that the distance between bearings be kept as short as possible, and to do this successfully, internal, specially designed, large diameter, grease-lubricated bearings are essential. Summarizing the effect of a long distance between bearings, we have:—

(a)—Increased deflection of rotor.
(b)—Increased neck-ring clearance.
(c)—Increased leakage from delivery to suction.
(d)—Increased wear thereby, and
(e)—Decreased efficiency.

Turning now to the dimensions of the rotor, the table shows the diameter of the shaft does not increase as fast as the length of span increases. However, a very serious increase in size (1.6 times) is entailed by the increase in span consequent upon changing from two internal bearings to two external bearings. Obviously increasing the diameter of the shaft will give the decreased deflection desired, but then it introduces a larger diameter of impeller boss and entrance eye, thus bringing about a corresponding drop in efficiency as well as more leakage owing to the larger leakage area consequent upon the increase in diameter of the boss and the neck-rings. It is clear, therefore, that securing the stiffness of a shaft by increasing its diameter is an inefficient method, for, besides the increased area for leakage through the neck-rings, we have much worse conditions of entrance in larger and more rapidly rotating eye and inlet edge of the impeller vanes.

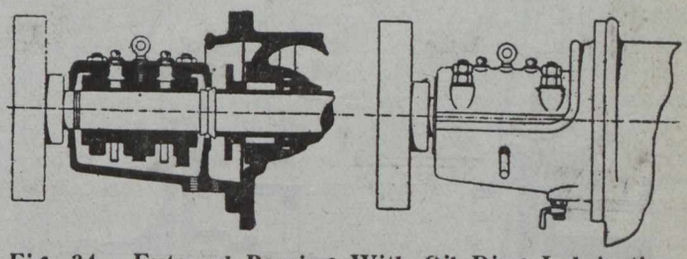


Fig. 34.—External Bearing With Oil Ring Lubrication

The desirable condition, therefore, from all points of view, is to use the smallest diameter of shaft with the shortest distance between the bearings.

Leakage Between Rotor and Stator

The leakage through the neck-rings may now be considered under different conditions and clearances. The material of these rings is the first important consideration. It is obvious that a material should be adopted in the first place of such a type that it will not tend to drag or tear if accidentally touched or rubbed by the running impeller. Material of a hard "short" nature like cast iron will meet this condition, and in practice the smallest clearance can be successfully run with such neck-rings; they are, however, subject to corrosion, particularly with acid waters, as are frequently met with in mines.

The impeller, for the reason of susceptibility to corrosion, together with considerations of the necessary strength to resist the centrifugal effects of high speeds, is usually made from phosphor-bronze; we therefore frequently get in practice phosphor-bronze impellers running in phosphor-bronze neck-rings, though it is obvious that dissimilar metals would be preferable. A phosphor-bronze impeller with a cast-iron neck-ring is a better combina-

tion, and will run with smaller clearances, but to get over the corrodibility of the cast-iron it should be specially treated, or should be similar to that indicated for renewal balancer rings.

Soft metals will not run with fine clearances, for, if any rubbing is set up temporarily or otherwise, through dynamic out-of-balance, or want of alignment from any cause whatever, the metal immediately drags and the pump seizes up. The softer the metal the greater the clearance necessary. White-metal neck-rings have been tried, but were for this reason a failure. Lignum vitae is possible, but owing to its uncertain expansion, a liberal clearance allowance must be made; it provides, however, a material to meet special conditions (mostly stay-bearings in vertical shafts). Lignum vitae is also frequently used in water-turbines, tail-shaft bearings for ships' propellers, etc. The form of the neck-ring is, in practice, confined to four forms:—

(a)—Internal.
(b)—External.
(c)—Vertical.
(d)—Labyrinth.

Types of which are illustrated in Fig. 31.

The first is the usual form in turbine-pumps, the second is more rare, the third is practically restricted to single impeller low-lift centrifugals, while the fourth is a refined form after steam-turbine practice, and is used in some high-lift pumps.

Between (a) and (b) there is little to choose, but for manufacturing reasons, (a) is usually preferred. Clearances of a few thousandths of an inch per side can be run

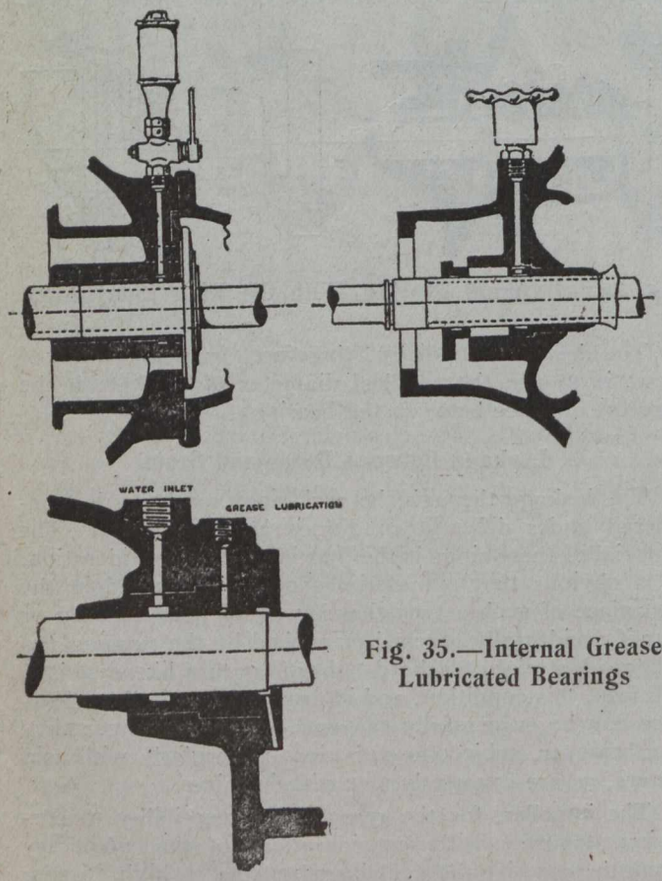


Fig. 35.—Internal Grease-Lubricated Bearings

with a suitable shaft, and the leakage is very slight, less than 1 per cent.

(c)—The vertical form is used in pumps for low lifts subject to dirty water and inferior attention. It allows of downward wear of the impeller without any rubbing surface coming in contact with the liquid, which (a) and (b) would not. (d) is an attempt to reduce leakage further by a device of the kind used on the steam-turbine.

For the reason that the labyrinth type deals with a non-expansible fluid like water, and not steam, it is far less effective than in the steam-turbine, and in fact can only restrict leakage by the formation of eddies in the channels or grooves; shock losses at the sudden changes

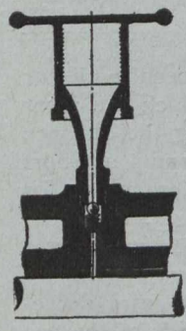


Fig. 36.—Hand-Operated Grease Lubricator

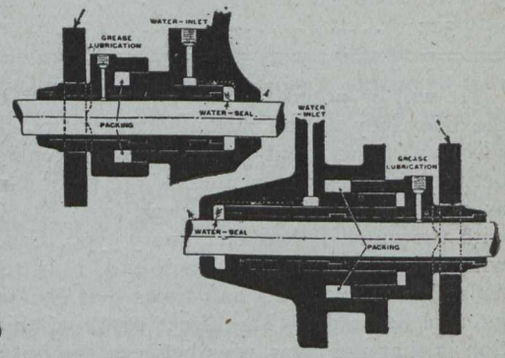


Fig. 37.—Suggestions for Special Gland Bearings. Loose Flange Bearing on Two Rounded Points Only

in area and direction, and the centrifugal effect of the rotating film of water in the narrow aperture. Its possible advantages in this way are more than negatived by its fragile nature if it comes in contact with the impeller, such a contingency usually involving the eventual renewal of both parts. Types (a) and (b) only require a new neck-ring for after wear. All types, however, are readily made with loose rubbing rings which may be easily changed.

In practice it has been found that when grooves were cut on the impeller-shoulders to secure a labyrinth effect, and at the same time the neck-rings were left plain, that after running for some time the marks of the grooves were always found on the neck-rings; the difference between the worn surface and the original surface often being as much as ten thousandths of an inch, showing in these cases a deflection of the shaft greater than the calculated value. In these particular cases the fact that the grooves appeared all round the ring to the same depth, indicated that they were due to actual deflection and not faulty alignment, the reasons for which may be found in the causes already enumerated and in mechanical inaccuracies.

When interlocking grooves are used, the difficulties of erection and dismantling are increased unless the interlocking is in the plane at right angles to the axis of the pump; any other arrangement is, of course, only possible with horizontally split pumps or with split or divided neck-rings.

The Bed and Other Details

In the past, less importance has been placed in the effect of the bed-plate than is now the case, with the result that frequently very shallow depths were used. These early beds were much too weak to resist warping strains due either to the unevenness of the foundation surface, the "pull" of holding down bolts, or to the reaction of the torque from the motor-end. It was a common practice to design bed-plates in the form of two separate horns or branches, and in this case deeper sections were generally employed. This form of design while undoubtedly stronger against bending depends too much upon the skill of the plant erector and the solidity of the foundation to always give good results.

It must be obvious that if fine internal clearances, such as have been dealt with, are an advantage, then the common base for the lot—the bed plate—must be of a nature to ensure the clearance remaining concentric and also to maintain true alignment with the operating motor. For these reasons deeper sections than are usual are an advantage.

With the "ring-type" of casing the bed-plate plays a more important part than with the "cylindrical" type on account of the lesser intrinsic rigidity of the contiguous type and the greater necessity for a plane true surface in erecting; hence the importance of deeper sections becomes more pronounced still. It is now customary to have supporting feet on each "ring" of a multi-chamber pump, probably more for the convenience of re-erection in awkward situations than for any necessity for actual support. Chambers, when dismantling or re-erecting, require to be slipped along the spindle and bed, and for this reason it is usual to machine the latter for its full length.

An example of substantial base-plate provision for a "cylindrical" casing is shown in Fig. 32, and a bed as recommended for a "ring" casing pump is shown diagrammatically in Fig. 33; in cases where there is a heavy torque from the driving motor, diagonal ribs as shown are most valuable in resisting twist on the bed.

Bearings

The almost "standard" speed of 1,450 revolutions per minute for operation of turbine-pumps does not require water-cooled bearings. For outside bearings good design oil-ring lubricated type as shown in Fig. 34 are used, a recommended feature being the provision of a thrower or guard to prevent water from a leaking gland entering the oil well and washing out the oil.

As has already been stated, to keep the distance between shaft supports as short as possible involves the use of internal grease-lubricated bearings, typical designs of which are shown in Fig. 35. This type of bearing, when carefully designed, can be made to operate very satisfactorily in practice despite a contrary view held for some time by some constructors. The important point of arranging for similar hydraulic pressures at each end of an internal grease-lubricated bearing, so as to prevent any risk of flow through the bearing surfaces must be rigidly followed for best results.

The charging and supplying of grease to internal bearings requires proper lubricators. The ordinary "Stauffer" is unsuitable, though generally a hand-operated appliance of simple design (such as Fig. 36) meets the case; a long trumpet-shaped entrance is essential in order to force against the high pressure due to the head of water against which the pump is working. The selection of a good quality grease lubricant suitable for operating in water plays an important part in the satisfactory lubrication of a bearing.

Stuffing-Boxes

It is doubtful is we can accept the customary stuffing-box and gland as good and satisfactory practice. The functions of its detail are on the suction or vacuum end to prevent air-leakage into the pump, and on the delivery end to prevent pressure leakage from the pump. The action of "packing" on rapidly rotating shafts is so severe as to demand the omission of a stuffing-box wherever possible. On the delivery end of a pump it is easy to avoid a gland either by closing-in the spindle (Figs. 3, 23, and 25), or by so reducing the pressure in passing through an hydraulic balancer that there is no pressure against which to pack (Figs. 4, 12, and 13).

Some constructors have done without stuffing-boxes at both ends of the pump for some time, and they generally rely on pressure water from the pump itself supplying the necessary packing to prevent access of air to the suction inlet. The possibility of difficulty in starting up a pump before the water packing is available should be carefully considered when this method is adopted.

Suggestions for the substitution of a special form of grease-lubricated, gland-bearing without any packing in contact with the rotating spindle, are shown in Fig. 37. Though these bearings are not arranged with end pressure in equilibrium, there is no tendency for water to pass over the bearing surfaces as leakage will take place from the water sealing ring to the reduced pressure of the suction inlet.

THE COAL SITUATION

SIR GEORGE FOSTER, Minister of Trade and Commerce, made the following announcement last week in the House of Commons, in reference to the coal situation:—

The production last year of non-anthracite coals in Canada amounted to 13,800,000 tons. Of that production a little over 6,000,000 tons came from the Maritime Provinces (Nova Scotia almost entirely); 2,860,000 tons was raised in British Columbia, 4,300,000 tons in Alberta, and a small proportion in Saskatchewan, making altogether the amount raised about 13,800,000 tons. That, however, was not sufficient for the needs of Canada, and in addition to that about 13,000,000 tons of bituminous coal had to be imported from the United States. Of the importation of bituminous coal, about 2,500,000 tons went to Quebec, 5,500,000 tons to central Ontario, 5,000,000 tons to the Georgian Bay and lake ports. The importation of 13,000,000 tons and the amount raised in Canada of 13,000,000 tons represent our available supplies for consumption after deducting about 1,800,000 tons, which was exported for bunkerage and other purposes, and some little which was exported to the United States. That is the situation in reference to the bituminous part of the coal business.

Dependent on United States

As regards anthracite, we are dependent for our supplies under present circumstances on the United States. Last year 4,500,000 tons of anthracite were imported into Canada. About one-quarter of a million tons went to the Maritime Provinces, a little over 1,000,000 tons went to Quebec, a little over 2,000,000 tons to Ontario, and a small proportion—half a million tons or so—to Manitoba and the near west provinces. In addition to the bituminous coal amounting to 13,000,000 tons imported, we imported anthracite coal to the amount of 4,500,000 tons, making a total importation of fuel coal for domestic and industrial purposes of 17,500,000 tons.

Anthracite stocks in this country were pretty well lowered last year, or at the end of the last coal year, and probably 1,000,000 tons extra will have to be imported of anthracite in order to make up for the deficiency, which means that we are dependent upon the United States for about 18,000,000 tons of coal.

With reference to our own production of coal, there is not any possibility that I can see that the amount raised this year will be in excess of the amount raised last year.

In the West there have been coal strikes, and consequent delays and confusion, which have reduced to that extent the possible output. In Nova Scotia the shortage of labor, owing to enlistments and other causes, has been so great that it has been impossible for them to add to the production this year. On the other hand, the consumption demand in the Maritime Provinces has increased and the situation in that respect is that what is raised in the Maritime Provinces will not be more than sufficient to take care of the needs or demands of the Maritime Provinces. What formerly came to Quebec (quite a large proportion of it from the bituminous output of Nova Scotia), will have now to be supplied by imports from the United States.

Why Shortage is Feared

That is the situation in so far as Canada is concerned and therefore the situation in the United States becomes of more interest to us. What, then, in its brief and broad features, is the situation in the United States? The normal output of anthracite coal in the United States is between 67,000,000 and 68,000,000 tons—last year it was 67,700,000. The output of commercial bituminous coal in the United States, sold on the market, last year was 509,000,000 tons. The beginning of the coal year, the first of April, had found the supplies in stock not very large, but production, despite all difficulties, has increased from April up to the present time and the total amount raised, both anthracite and bituminous, for the period of the present coal year has been considerably in excess of what was raised last year.

The question comes: If there is any amount of coal in the United States and the output has increased as compared with last year, why the high prices and why the consequent fears of shortage? There are several principal reasons for it. In the first place there is a vastly increased demand in the United States for industrial and war purposes. The increase of steel which is computed to be necessary this year and which will be forthcoming, calls for an increase of 40,000,000 tons of coal for that special production alone. The cotton textile factories, the munition factories and other industries, stimulated now by war needs, are calling for increased quantities of coal. The railways have to do the hauling and it is computed that the railways this year will require thirty per cent. more coal for haulage purposes than they consumed last year, which works out at about an extra amount of 40,000,000 tons or over. That has to be taken into account and it is not possible or probable that the demand will be decreased. In proportion as industry carries on its work of war preparation coal becomes more and more necessary.

The Transportation Situation

One cannot understand the coal situation in the United States, even comparatively, unless he also takes into account the transportation situation which is so intimately connected with the distribution and even the production of coal, as tardy or speedy distribution forms a most important element in coal mining. There has been a comparative shortage of railway transport for coal purposes. Barges and ships along the Atlantic coast and barges and ships on the lakes have been transferred in large tonnage quantities from the carriage of coal to the carriage of more remunerative freights. Many of these vessels, both on the lakes and on the Atlantic coast, have been diverted into war activities, either by purchase or by charter. Thus there has been and is a shortage of shipping carriage for coal. With reference to the railways, the demands upon them for the carriage of other freight than coal have been very great. They have not in the United States a co-ordinating body such as our Railway Commission, but, in order to cope with the situation, some months ago the railroad presidents of the United States met in Washington and voluntarily submitted themselves to the regulative control of a committee of five or six railway men. The American railroads are now administered as if all were under one system and managed by this railroad war committee. As a result of their work, voluntary entirely, they have cut out, up to the present, more than 16,000,000 miles of train services and have thus saved thereby 1,120,000 tons of coal, which motive power, man power, and fuel power can now be diverted to more necessary carriage. They have also taken hold of the car distribution and within the last three months have diverted 106,000 empties from railways where they could be spared to railways and districts where they were more necessary and where they could do better service. That shows the improvement that is taking place.

One point to be taken into consideration is that most of the mines in the United States have not storage facilities. They depend upon the coal being carried away as soon as it is raised; and it is the custom of the men in most of the mines, I am told, not to go under ground unless the cars which are to take the product away are there ready for loading; and if the cars are delayed and are not available for loading, no work, or less work, is done in the mines, and to a corresponding extent there is disorganization and confusion amongst labor itself. A part of the shortage which has occurred is, of course, due to the transference of alien laborers by hundreds of thousands from European countries to the colors of those countries.

Fuel Controller at Work

As to what is being done in Canada, the fuel controller and his aide are busy at work on two lines, first to co-ordinate the activities of the dealers and shippers and the transport facilities in Canada with a view to equal distribution of the coal when it once arrives at the border, and, second, to look after the supplies that are necessary in the various sections, to ascertain what they are and to make arrangements for their being filled. On the other side of the line the work of the fuel controller and his aide is to keep in co-operative touch with the authorities, the coal miners and operators, the transport facilities, and so on, as well as with the government authorities, to work in touch and unison with them, to get their sympathy and their aid so far as possible. These two lines of their endeavor are being carried on with great pertinacity I know, and I think with very considerable success.

From this short survey of the situation two things are patent as to what Canada will be required to do. It is not impossible, with the wide powers that have been conferred upon the President of the United States and with the work that is being done to ascertain and to regulate the prices and the output, and with the wide powers that we possess to regulate prices and tariffs, that, if activities are maintained as they now are, both the United States and Canada will be, to a certain extent, put upon rations with regard to coal, as distinguishing between absolutely necessary services and services which are not so necessary and which may be dispensed with. In Canada we are taking measure to bring about a complete co-ordination between the different railway companies as to the disposition of cars and the direction of traffic with the view to the saving of coal, just as we are saving in foods.

I believe myself that this is absolutely necessary, and that we can do a great deal in that way.

I have not given to the House particular figures with regard to particular lines that are being followed; it is, perhaps, not best that I should. With reference to the lakes, honorable members will have observed last night that orders have been issued by the Washington authorities to several of the great railway lines to give preference to coal carriage from the mines up to the ports on the lakes so as to provide for the supplies which are necessary to go to those lakes during the open navigation season in order to provide for winter necessities.

I have endeavored to give, as briefly as possible, an idea of the general situation.

CO-OPERATIVE RAILWAY MANAGEMENT

Co-operative management of all the railways of Canada, not only during the war but for all time to come, is the goal which the government has in view, according to an announcement last week in the House of Commons by the prime minister. Sir Robert said, in moving the third reading of the C.N.R. bill, that the question before the House was whether the Canadian Northern Railway would be taken over by the Canadian Pacific or acquired by the government.

The C.P.R., he said, claimed that by acquiring the Canadian Northern it could save $100,000,000 that otherwise will have to be expended in unnecessary construction work. This admission, said Sir Robert, was the key to the whole difficulty of the Canadian railway situation. It meant that the country is burdened with unnecessary duplication in railway construction and railway service. The roads must come under some co-operative management and for that purpose the railway companies must without delay get into conference with the government. With proper co-operative management, $100,000 a year would be saved in operating expenses and hundreds of millions of dollars will be saved in unnecessary construction.

He pointed out that what had been done in England could be done in Canada. The acquiring of the Canadian Northern would be the first step in a broad program of public ownership. That road, he declared, should not be absorbed by the Canadian Pacific, but at the same time it should be operated by the government in such a way as to prevent unnecessary duplication of service or construction.

OTTAWA BRANCH, CAN. SOC. C.E.

J. B. Challies, secretary of the Ottawa Branch of the Canadian Society of Civil Engineers, announces a special meeting of the branch to be held at 8.30 o'clock Friday evening, September 7th, in Machinery Building, Lansdowne Park, to inspect the exhibit of lighthouse and fog alarm apparatus arranged by the Marine Department. Lieut.-Col. W. P. Anderson, C.M.G., will give a short address on the optical and acoustic principles, and the apparatus will be further explained by F. P. Jennings, A.M.Can.Soc.C.E. Through the courtesy of the management of the Central Canada Exhibition, entrance to the grounds will be free and a limited seating accommodation will be provided for ladies. Friends of members will be welcome.

ENGINEERS MEET AT MOOSE JAW

By Jos. N. deStein, C.E.
Secretary-Treasurer, Saskatchewan Branch, Can.Soc.C.E.

Since the Regina Branch of the Canadian Society of Civil Engineers changed its name to "Saskatchewan Branch" a few months ago, the by-laws have contained a clause whereby an annual summer meeting is to be held in one of the cities of the province, other than the city of Regina, which is the branch headquarters.

As soon as the official notice was received that Fraser S. Keith would be in our vicinity about the middle of August, plans were made whereby the first annual summer meeting of the branch (in Moose Jaw) would be made to coincide with the visit of our secretary, and August 18th was decided upon.

On Friday, the 17th, Mr. Keith arrived at Regina and was met at the depot by the officers of the Saskatchewan Branch. After spending a few hours in the capital city of our province, Mr. Keith left for Moose Jaw, to which place a considerable number of the Regina members of the branch sojourned on Saturday morning. An extensive program had been arranged and it certainly kept everybody busy to live up to it.

Upon arrival, the extensive yards of the Canadian Pacific Railway were visited. They contain about 65 miles of tracks, and even this large space is insufficient during the grain rush. After a joint luncheon, the members and visitors were conveyed in a number of automobiles to the packing plant of Gordon, Ironsides and Fares, where the modern refrigerating machinery and the huge quantity of frozen meats ready for shipment to France, proved very interesting. The plant of the Moose Jaw Brewing Co. was visited, and the Military Hospital (under construction) was inspected. An inspection of the sewage disposal works brought the afternoon program to a conclusion.

While most of the members were entertained by a special alarm of the Moose Jaw fire department and a turnout of the motor brigade, several committees of the branch met in the City Hall. At the executive committee meeting, Fraser S. Keith was present and a number of matters pertaining to the co-operation of the branches with the parent society were discussed. It was felt especially that branches could render a considerable service with reference to classification of applicants from their respective districts.

The creation of a provincial library was decided upon, and a number of donations of engineering works promised.

Saskatoon was chosen for the next annual summer meeting, and it was suggested to try and arrange a meeting of all western branches to coincide with the proposed summer meeting and to ask the council of the parent society at Montreal for official representation at this occasion.

The nomination committee drew up a slate of officers to be submitted to the members of the branch for election before the next annual meeting. The paper and library committee decided upon a program for 1918.

At the Royal George Hotel a banquet was tendered the branch by the city of Moose Jaw, Acting Mayor G. C. Ingram presiding.

The banquet was followed by a regular meeting of the branch, at which a resolution was read, which will be presented shortly to the provincial government. At the conclusion of the business portion of the meeting Mr. Keith gave a very interesting address on the aims of the society.

LORD SHAUGHNESSY ISSUES STATEMENT OUTLINING ATTITUDE ON C.N.R. BILL

Lord Shaughnessy, president of the Canadian Pacific Railway, last Monday issued the following statement, outlining his attitude in regard to the C.N.R. legislation, and replying to the allegations made by Conservative members of the House of Commons, to the effect that the C.P.R. had been the inspiration for the opposition to the bill:—

"I wish to deny most emphatically the statement published in a number of newspapers, and evidently inspired, that the Canadian Pacific Company is offering organized opposition to the Government proposals about the Canadian Northern Railway. Up to the present time no effort of any kind has been made by the company to influence the vote of a single member of the House of Commons or the Senate upon the measure now before parliament.

"This reference to the Canadian Pacific is the same old threadbare ruse to which resort has been had on more than one occasion during the past thirty years when railway schemes of one character or another were being considered by parliament.

"It is true that the acquisition of the Canadian Northern by the Canadian Pacific was discussed by representatives of the parties concerned, but the discussion was at the suggestion of members of the Dominion Cabinet.

"After a time it was evident that no transaction was possible and negotiations were dropped.

"The fate, or destiny, of the Canadian Northern is not a matter of special moment to our company as a common carrier, but the company having enough interests in Canada naturally views with apprehension the possibility of the payment of an excessive price for the alleged equity of the holders of the majority of the stock, and feels that some less speculative and more direct means should have been used to fix the amount than the very uncertain process of arbitration.

"It is to be hoped that if the transaction is carried out, the country will not, in consequence, be saddled with heavy liabilities heretofore undisclosed, and that in fixing the amount to be paid under the arbitration proceeding no consideration whatever shall be given to personal investments in unfortunate ventures, such as coal mines, lumber mills, blast furnaces and other works alleged to have been undertaken for the advantage of the Canadian Northern enterprises, but being in fact private speculations of the promoters of the railway company."

The fall convention of the Portland Cement Association will be held at the Blackstone Hotel, Chicago, Ill., on September 10th to 13th, inclusive.

The contractors' plant of the Lyall-Mitchell Co., Limited, of Winnipeg, is being offered for sale en bloc or in part by the Traders Trust Company, of Winnipeg. The plant consists of hoists, motors, concrete mixers, gas engine, centrifugal pump, miscellaneous tools, etc.

A telegraphic despatch sent from Quebec city on September 1st by the "Canadian Press Despatch" Service, and published in daily newspapers throughout Canada, says that "reliable information authorizes the announcement that the centre span of the Quebec bridge will not be put in place before September 14th, probably later."

The filtration plant which is being built at Oshawa, Ont., by the ver Mehr Engineering Co. has four square filter tanks, constructed of reinforced concrete. Four filtering cones will form in each tank. The outer walls of the filter building will provide two of the four walls for each tank, one tank being built in each of the four corners of the building. The filtration principle will be the same as at the new Toronto plant. The Oshawa plant will have a capacity of 1,200 Imperial gallons per minute.

The road map of New York State, recently issued by the New York State Commission of Highways, shows 6,500 miles of completed state and county highways, 1,500 miles of state and county highways under construction, 4,300 miles of roads that have been improved by towns or counties, and approximately 6,500 miles of unimproved roads. There are about 80,000 miles of highways in the state, outside of the limits of cities and incorporated villages.

PUBLIC OWNERSHIP IN ONTARIO

Messrs. McCarthy and McCarthy, Toronto, solicitors for the petitioners in the case of the Electrical Development Company v. The Attorney-General of Ontario, before the Judicial Committee of the Privy Council, have prepared, for inclusion in the petitioners' brief, a "memorandum concerning recent provincial legislation and executive action in Canada, with special reference to the Niagara question in the Ontario legislature." The memorandum states with some fullness the economic as well as the legal and constitutional arguments against the legislation in question.

Among the general conclusions of the memorandum are the following:—

While the control and inspection of industrial undertakings may properly be entrusted to a public authority responsible to the people, such functions cannot with safety to the public interest be entrusted to irresponsible commissions.

It is still more disadvantageous to the public interest to endow irresponsible commissions with powers to expropriate private property and to conduct industrial enterprises.

Under the name of "public ownership" small groups of persons have been endowed by provincial legislatures, and in particular by the legislature of Ontario, with powers of an exclusive and monopolistic character, without adequate constitutional checks upon their proceedings. Such commissions have been rendered exempt from control by the legislature, and at the same time have been rendered immune from proceedings in the law courts.

The Ontario acts have placed many municipalities of Ontario wholly at the mercy of the commission in question, and have by so doing seriously infringed upon municipal autonomy. Experience has shown that, deprived as the governments and legislatures are of effective checks upon the commissions, these bodies have involved the provinces in financial obligations for which there was no parliamentary warrant. The embarkation of the province of Ontario in extensive engineering schemes, even if these were properly estimated and adequately investigated, is clearly inexpedient at the present critical time, when the resources of the province are already heavily engaged, and may ere long be still more heavily engaged in providing the means necessary for the conduct of the war and afterwards for the liquidation of its cost.

The schemes of the Ontario Hydro-Electric Commission cannot possibly be carried out without revision of the treaty between Great Britain and the United States respecting the international waterways.

The following practical suggestions may be added:—

1. That the attorney-general of Ontario should be strongly urged, on grounds of public policy, to grant a fiat or fiats in order that the legal questions connected with the development of power at Niagara may be thoroughly settled in the courts.

2. That the prime minister of Ontario be strongly urged, on grounds of public policy, to disclose without delay the terms of the report upon the Hydro-Electric affairs by Mr. Clarkson, C.A.

3. That at the present time no unnecessary public works should be undertaken.

4. That at the present crisis in international affairs no steps be taken which might involve Great Britain and the United States in renewed controversies over boundary waters.

5. That the legislation respecting the Hydro-Electric Commission in the years 1916 and 1917 be disallowed as contrary to public policy.

Plans for the establishment of steel and allied industries on the Pacific coast on a large scale, which were in preparation before the war, have now been revived and are about to be consummated, according to William H. Crocker, financier, San Francisco, who is interested in the undertaking. The plan involves the erection of large plants on Lake Washington, near Seattle, Wash. The plan involves the bringing in of pig iron from China and coal from Alaska, the development of the iron ore and coal resources of the Pacific slope, the manufacture of ship plates for the Government merchant marine, and the turning out of pig iron, steel, and varied steel products and by-products.

Editorials

ENGINEERS AND GOVERNMENT

The science of government, or more especially its practice, is something which affects every individual ruled. If his life be not particularly touched, his pocket certainly is.

One English premier defined the task of government as that of making virtue easy and vice difficult. In other words, encouragement of right and suppression of wrong are the main features of public administration.

In a democratic country, under all existing systems, there are almost as many drawbacks from perfection as under an autocracy. In literal fact, beneficent autocracy is by no means an inherently bad thing.

History has, however, shown that save in exceptional cases unbridled power leads too often to license and abuse. Moreover, commonsense prefers collective responsibility and direct popular control.

Another English premier, not in office at the time, proposed in a speech an ideal system to combine the two. A single individual was to be chosen by popular vote, and into his hands was to be committed absolute power and responsibility, the time of office to be limited and the occupant to be executed at its termination. This latter provision was an unfortunate necessity but it was argued that it would provide against abuse of power.

Ideal systems have been many. The best known, perhaps, is that of More's "Utopia." Meeting practical conditions, however, the populace may be said to be the shareholders in the national concern; the elected representatives, the board of directors; while the executive administration is delegated from parliament as a whole and is responsible thereto and so indirectly to the people at large.

As in a commercial concern, it is necessary first that the directors have valid qualifications and that the executives have expert knowledge of the business.

The legislature is the nation in miniature, or should be so representative. Once having elected its member, the constituency in voting has delegated its authority into the keeping of that individual.

It is important, first, that all interests of the populace be represented, and second, that its affairs be entrusted to men of real capacity. While commercial interests bulk largely, labor also is increasing in strength and agricultural interests have a good showing; but many professions full of able and public-spirited men are excluded.

The engineer is very rarely found active in public affairs although he has had a training which qualifies him for office in no mean or unworthy manner. This condition must be changed at an early date. The engineer's actual stake in the community is very large; the interests of which he is custodian are incalculable; he is a man of considerable mentality, fertile in resource, and trained in expedient. Upon his shoulders in normal times rests a large administrative load. Why should not the country have the benefit of his experience? No one is more fitted; no one more highly trained. Think it over and, in coming elections, if you are nominated for any public office whatsoever—whether as reeve or premier—accept! It is your duty to the profession.

THE GRAND TRUNK PRESIDENCY

Members of the Canadian Society of Civil Engineers will rejoice that one of their number has been elected to the very responsible position of president of the Grand Trunk Railway System. Howard G. Kelley's engineering and executive ability is well known and there is no doubt but that his presidency will mark a new era for the Grand Trunk, provided that a Canadian board of directors is formed which will be more closely in touch with affairs than is the present board, and provided that Mr. Kelley is given an entirely free hand and permitted to use the dividends for betterments if he so desires.

The Grand Trunk System is a large one, even on this continent of large railway systems, and Mr. Kelley's work will be arduous and fraught with the gravest responsibilities, not only to the shareholders of his road but to the country of which he is a citizen.

The latest available statistics show that the Grand Trunk operates 4,788 miles of track, not including over 1,500 miles of sidings. The length of its operated roadbed is a little more than 4,000 miles, of which over 700 miles is double-tracked. The system is divided into three operating divisions, *viz.*, the eastern division, including thirteen districts; the Ontario division, having fourteen districts; and the western division, with five districts.

The Grand Trunk has an equipment of 1,143 locomotives and about 41,000 cars. The gross receipts of the system for some years past have been between $40,000,000 and $50,000,000 per annum. About 20,000,000 tons of freight are hauled each year, and about 12,000,000 passengers are carried. The share capital of the road is approximately $250,000,000 and the total assets exceed $500,000,000.

The system also controls many other important railway companies, such as the Central Vermont and the Grand Trunk Pacific, the figures for which are not included in the above statistics, which will also come under Mr. Kelley's jurisdiction.

Mr. Kelley has taken over his new duties at a somewhat critical period in the Grand Trunk's history. The Drayton-Acworth report indicates the size of his problem. Shortage of cars and motive power will no doubt worry him not a little, and his troubles will not be lightened by the changed aspect of the Canadian Northern competition under government ownership, nor by the strong tendency toward public ownership of his own railway.

Mr. Kelley will have need for all the ability and capacity for work with which he is rightly credited. We believe that the Grand Trunk directors have chosen wisely. Mr. Kelley will have the best wishes of all engineers throughout Canada in his endeavors to strengthen the position of the Dominion's pioneer railway.

THE NEXT WAR LOAN

Canadians will be asked to subscribe to another war loan during the coming fall. The amount will probably be $150,000,000. As the third war loan has only recently been entirely placed with the ultimate investor, the natural market for the next loan is restricted. It is therefore every Canadian's duty to save money NOW.

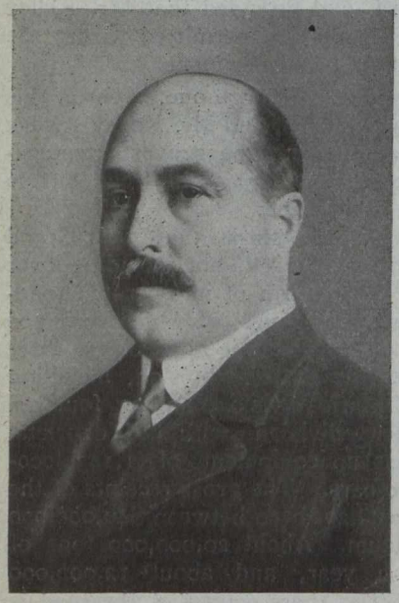
PERSONALS

HARRY ROY SILCOX, B.Sc., has been appointed acting resident engineer, C.P.R., Toronto.

T. KING has been appointed superintendent of the Detroit division of the Grand Trunk Railway.

Capt. ALEX. C. LEWIS, secretary of the Toronto Harbor Commission, has been wounded in action.

HOWARD GEORGE KELLEY, C.E., vice-president in charge of operation, maintenance and construction of the Grand Trunk Railway, was elected president of the G.T.P. and of the G.T.R. last week in succession to E. J. Chamberlin, who resigned. Mr. Chamberlin remains a director of the G.T.R., and Mr. Kelley was also appointed to a seat on the board of directors of both companies. Mr. Kelley is a graduate of a Pennsylvania engineering college, and has been a member of the Canadian Society of Civil Engineers since 1907. He began his railway career in 1881 with the Northern Pacific Railway as assistant engineer on location, construction and bridge building. He was attracted from the railway to the mining field in 1884, and engaged in mining operations until 1887, when he accepted the position of resident engineer and superintendent of bridges and buildings on the St. Louis Southwestern Railway System, including the St. Louis Southwestern Railway of Texas and the Tyler Southeastern Railway. Three years later he was appointed chief engineer of the St. Louis Southwestern System, a position which he held until March, 1898, when he became consulting engineer of that road, being at the same time chief engineer of the Minneapolis and St. Louis Railroad System, in charge of the construction, maintenance and real estate departments. In 1900 his responsibilities were further increased by his appointment as chief engineer of the Iowa Central Railway. In 1907 Mr. Kelley joined the Grand Trunk Railway System as chief engineer, four years later being promoted to the position of vice-president. The American Railway, Engineering and Maintenance of Way Association elected him president in 1905.



W. D. L. HARDIE, mining engineer and mayor of Lethbridge, Alta., has been elected president for the coming year of the Union of Canadian Municipalities.

W. R. DAVIDSON has been appointed general superintendent of western lines of the Grand Trunk Railway, with headquarters at Chicago. Mr. Davidson was superintendent at London, Ont.

J. K. MCNEILLIE, general superintendent of the Canadian Government Railways, Moncton, N.B., has resigned in order to accept a position on the Delaware and Hudson Railway under F. P. Gutelius.

J. H. SMITH, Dominion land surveyor, is in the Royal Alexandra Hospital, Edmonton, Alta., where he has undergone an operation in consequence of an injury received while on survey.

J. E. PINAULT has resumed his duties as general superintendent of the Canada and Gulf Terminal Railway, Matane, P.Q. He went overseas in September, 1916, as major in the 189th Battalion and was recalled to Canada to recruit railway construction men. He is now a reserve officer, C.E.F.

C. J. DEFBAILLETF, Montreal, has been appointed manager and engineer of public utilities, including the light department, of the city of Sherbrooke, P.Q., and took up his duties on September 1st. Mr. Defbailletf is succeeded by E. O. BROWN as electrical engineer of the Canadian Westinghouse Company, Montreal division.

Captain J. D. RUTTAN, of Winnipeg, has been appointed captain and adjutant of the No. 10 Forestry and Railway Construction Depot. Capt. Ruttan was formerly attached to the 9th C.M.R.'s but he transferred to the First Pioneer Battalion, with which he went overseas in 1915. He was invalided home some time ago.

Private ALAN W. GROVES, of Toronto, has been admitted to No. 22 Casualty Clearing Station, suffering from gas poisoning. He went overseas in September, 1915, and was wounded on September 15th, 1916, having been erroneously reported killed on that date. Private Groves was an undergraduate of the University of Toronto and attended the School of Practical Science prior to his enlistment.

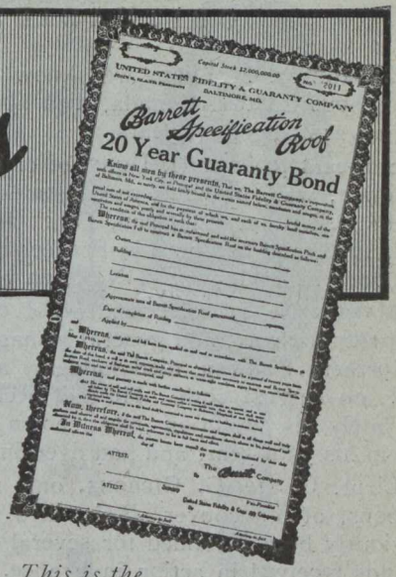
Major J. M. ROLSTON, M.Can.Soc.C.E., of Vancouver, B.C., has been created a Chevalier of the Legion of Honor, by the French government, for services in railway construction. He was graduated from the Royal Military College, Kingston, in 1900, and was for a time in the Grand Trunk Pacific Railway service, during the building of the mountain section. He was mentioned by Sir Douglas Haig in dispatches in February last.

W. D. ROBB, superintendent of motive power of the Grand Trunk Railway, has been appointed vice-president in charge of motive power, car equipment and machinery, with headquarters at Montreal. Mr. Robb was born in Quebec Province in 1857. He joined the G.T.R. when only fourteen years of age, and has been continuously with that railroad ever since in various positions connected with the motive power department.

U. E. GILLEN, general superintendent of the Grand Trunk Railway at Chicago, Ill., has been appointed vice-president in charge of operation, with headquarters at Montreal. Mr. Gillen was born in Missouri in 1867, and has been engaged in railway operation since seventeen years of age, when he joined the C. M. & St. P. Railway as a telegraph operator. He entered the G.T.R. service in 1901 as train master at Belleville, Ont., gradually rising until in 1913, he was appointed general superintendent. He is a member of the Railway Engineering Association.

GEORGE C. JONES, vice-president of the Central Vermont Railway, has been appointed assistant to the president of the Grand Trunk Railway, with headquarters at Toronto. Mr. Jones was born in New York State in 1860. He became a railway yard clerk in 1874, and was subsequently dispatcher on various United States railroads, becoming chief dispatcher of the Wabash about 1890. In 1896 he entered the employ of the G.T.R. as assistant superintendent, later being appointed superintendent. The Central Vermont engaged him as general manager in 1905, and he subsequently became vice-president of that road, and also vice-president of the Southern New England Railway.

Barrett Specification Roofs



This is the bond that guarantees your roof for twenty years.

Twenty Years' Service Guaranteed!

It is not an unusual occurrence to go into an enterprising Canadian city and find that most of the important buildings are covered with Barrett Specification Roofs.

And the popularity of Barrett Specification Roofs is not to be wondered at when you consider the following features.

First: Lowest unit cost per year of service.

Second: Freedom from maintenance expense.

Third: Take the base rate of fire insurance..

Fourth: And most important, we now guarantee these roofs for twenty years under the following conditions:

How to Secure the 20-Year Guaranty Bond

We are now prepared to give a 20-Year Surety Bond on every Barrett Specification Roof of fifty squares and over in all towns of 25,000 population and more, and in smaller places where our Inspection Service is available.

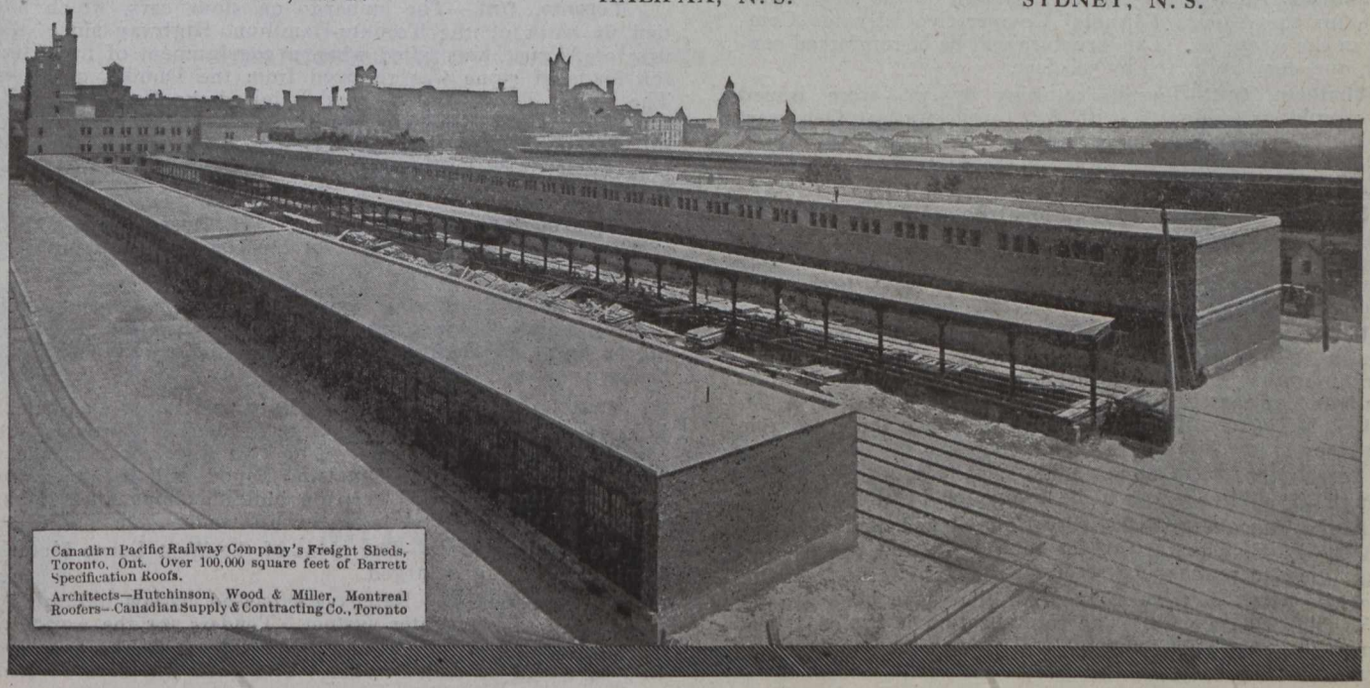
This Surety Bond will be issued by one of the foremost surety companies in America and will be furnished by us without charge.

Our only requirements are that the roofing contractor shall be approved by us and that The Barrett Specification, dated May 1, 1916, shall be strictly followed.

Further information and copies of The Barrett 20-Year Specification, with diagrams, free on request.

THE PATERSON MANUFACTURING COMPANY, LIMITED
MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED
ST. JOHN, N. B. HALIFAX, N. S. SYDNEY, N. S.



Canadian Pacific Railway Company's Freight Sheds, Toronto, Ont. Over 100,000 square feet of Barrett Specification Roofs.
Architects—Hutchinson, Wood & Miller, Montreal
Roofers—Canadian Supply & Contracting Co., Toronto

OBITUARIES

GEORGE M. MCLEOD, well known in railway circles throughout Eastern Canada, died at St. John, N.B., on August 21st, aged 65 years.

Sergeant ROBERT H. DUFF, officially reported as killed in action, was, previous to enlistment, resident engineer of the C.P.R. at Chapleau, Ont. He went overseas in July, 1916, and had been in France since March last. He was born in Bridgewater, N.S., 29 years ago.

MARTIN N. TODD, president of the Galt, Preston & Hespeler Railway, and general manager of the Lake Erie & Northern Railway, died suddenly at his home in Galt, Ont., on August 29th. He had been ill for some time, but lately his condition had shown improvement. He was in his 59th year, and had lived in Galt all his life.

Lieut. GWYNN G. GIBBONS, only son of Dr. Johnson Gibbons, of Vancouver, B.C., died at Saloniki, having previously been invalided for several months from severe wounds received in action in France. He was a mining engineer by profession, a graduate of McGill University, and was one of the engineers in charge of the erection of the C.P.R. viaduct, Toronto.

Lieut. WM. DOUGLAS SCOTT, of the Oxford Bucks Light Infantry, who has been reported killed in action, was graduated from the Science Faculty of McGill University in 1914, securing his degree of B.Sc. He was the class orator at the convocation that year, and was subsequently engaged by the government to survey the Rockies. He was a student member of the Canadian Society of Civil Engineers.

Coast to Coast

Aylmer, Ont.—Work has started on installation of hydro-electric power system, which will be 13,000 volt, and served from St. Thomas station.

Brantford, Ont.—During the month of August a total of thirty-three building permits were issued for an aggregate value of $10,945.

Calgary, Alta.—Work has been started on the large warehouse for the Alberta Farmers' Co-operative Elevator Company in the west end. The structure will be of reinforced concrete, one-story high, 100 by 300 feet.

Chatham, Ont.—Permits totalling $75,300 were issued last month, as compared with $26,219 in August last year. For the first eight months of the year the figures are $291,472, as compared with $243,849 for the first eight months of 1916.

Cravenhurst, Ont.—The National Potash Corporation are putting in concrete footings for new buildings and blast furnace to be erected here. The plant as planned includes evaporaters, boilers, condensers, dust collectors, chemical towers and nitrate towers.

Kingston, Ont.—Last week surveyors, who have been working from Napanee, surveyed Princess St. The survey is preliminary for the new provincial highway which is to be built from the eastern provincial boundary to Toronto. A. M. Rankin, M.L.A., is making an appeal to have the road from Port Hope to the boundary taken over.

Loretteville, P.Q.—A macadam road is being constructed through the village and will be completed by the fall.

North Vancouver, B.C.—City Council will obtain a price from the B. C. Electric Co. for their light and power plant with a view to purchasing same.

Olds, Alta.—Letters of incorporation have been granted to the Olds Electric Co. The capitalization is $20,000; head office, Calgary. The company will install and operate an electric lighting plant in this town.

Ottawa, Ont.—Among the sums voted at a previous session of parliament and now to be re-voted are $1,020,000 for the construction of the Welland Ship Canal, and $3,667,745 for the purchase of the Quebec, Montmorency & Charlevoix Railway, the Quebec and Saguenay Railway, and the Lotbiniere & Megantic Railway.

Ottawa, Ont.—Dominion Government voted $91,600 for a bureau of industrial and scientific research.

Port Arthur, Ont.—The work of pouring concrete for the storage tanks at the Saskatchewan Farmers' Co-operative Elevator Company's elevator at Current River, Port Arthur, is progressing. There are to be more than fifty large storage bins, as well as many smaller ones, in the first unit. The tanks will have a capacity of two million bushels, and the working house will take care of half a million, making a total initial capacity of two and a half million bushels. It is hoped that the elevator will be completed by November.

Quebec, P.Q.—It is expected that the addition to the Quebec Harbor Commissioner's grain elevator on the Louise Embankment, which is being erected at a cost of $250,000, will be completed by December 1st. The present capacity is one million bushels, and when the addition is completed its capacity will be two million bushels. An extensive addition is also being made to Shed 29. This will be finished by June 1st, 1918, and will cost approximately $350,000.

Rockwood, Ont.—It is reported that a prominent oil concern has leased an extensive tract of land here, and that drilling will be commenced at once.

Ship Head, Nfld.—Work on the new shipbuilding plant at Ship Head, Harbor Grace, Nfld., is going ahead well and it is expected that it will be completel even earlier than at first thought. The whaling factory which formerly occupied the site has been demolished and the new dock is rapidly assuming shape. Some 120 men are engaged at the construction work.

St. Lambert, P.Q.—The by-law covering the agreement between this town and the Dominion Textile Co., providing for the establishment of a large manufacturing plant has become operative without the necessity of a poll of the ratepayers.

Toronto, Ont.—During last month 301 building permits were issued, the total value being $1,105,318, while 414 permits were issued during August last year, value $850,801.

Toronto, Ont.—Ten thousand dollars' damage was done to machine shop owned by the Polson Iron Works, Esplanade East, when crane fell through roof.

Toronto, Ont.—The British Government representation reports the discovery of an eighty-foot layer of nickel and copper at the British-American Nickel Corporation's mine, near Sudbury, which will increase the present output five million tons annually.

Toronto, Ont.—The embargo on stone cars, which has tied up work on the Toronto-Hamilton Highway since the first of August, was lifted when a consignment of five fifty-ton loads of stone was received from the Dundas quarries. The Grand Trunk Railway has promised the Dominion Railway Board that everything possible will be done to hurry up shipments, and it is expected that at least five carloads per day will be forthcoming. Work on the highway has been recommenced.

Victoria, B.C.—City Engineer C. H. Rust is working on a scheme for the development of the coke and gas industry by the city.

Victoria, B.C.—Formal approval from a legal and engineering standpoint was recently given by City Solicitor Hanington and City Engineer C. H. Rust, to the Johnson Street bridge proposal.

Victoria, B.C.—The Whalen Pulp and Paper Co., which is engaged in establishing a large industrial plant on Vancouver Island, at the new town of Port Alice, near the head of the South-east Arm of Quatsino Sound, will lay down two keels at a time and will keep on building ships until it has enough of them to handle its export trade.

West Lorne, Ont.—The plant of the West Lorne Motors, Limited, is being enlarged.

Woodstock, N.B.—Ratepayers passed by-law authorizing installation of new water system. Tenders for the work, including a filtration plant and other repairs to the pumping station, closed on August 28th. The work will cost $60,000.

Construction News Section

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or projected, contracts awarded, changes in staffs, etc.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are printed in CAPITALS

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue.

Further information may be had from the issues of *The Canadian Engineer* to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Cobalt, Ont., installation of telephone system	Sept. 18.	Aug. 30.	48
Craigmillar, Alta., erection of school	Sept. 10.	Aug. 30.	50
Lundar, Man., completion of school	Sept. 15.	Aug. 30.	50
Ottawa, Ont., ribbed expanded metal and reinforcing steel corrugated plate	Sept. 10.	Aug. 30.	54
York County, Ont., construction of bridge	Sept. 7.	Aug. 30.	54

BRIDGES, ROADS AND STREETS

+—Blenheim Tp., Ont.—Contract let to STAUFFER & ZINKAN, care of township clerk, Hugh Allan, Drumbo, by the Township Council for the erection of two bridges.

+—Chateau Richer, Que.—LEONIDAS TREMBLAY and LOUIS VEZINA have been awarded contract for concrete and steel bridge by the Municipal Council.

Chatham, Ont.—The good roads committee of the Kent County Council, acting on the report of the newly-appointed superintendent of roads, L. A. Pardo, has made a recommendation to council that $12,000 be set aside at once to make necessary repairs on the main roads. The work will be commenced at once.

+—Chicoutimi Tp., Que.—Council let contract to the PROVINCIAL BUILDING AND ENGINEERING CO., 83 Craig St. West, Montreal, for 94,000 square yards of macadam highway costing $130,000.

Jonquieres, Que.—The Town Council is constructing one mile of macadam and one mile of Rocmac highway, costing $12,000. Engineer, J. E. Grennon, Chicoutimi.

London, Ont.—Board of Control decided to put down a sidewalk on Palmerston Street this year. City Engineer, H. A. Brazier.

+—Moncton, N.B.—WARREN BITUMINOUS PAVING CO., OF ONTARIO, LIMITED, McKinnon Building, Toronto, have been awarded contract for 2,600 yards of bituminous paving for the Canadian Government railways.

▲—Norwood, Ont.—Tenders will be received up to noon on Friday, September 14th, 1917, by V. W. Squire, Reeve of Norwood, c/o County Clerk, Peterboro, Ont., for a 40-ft. steel bridge superstructure, or for a concrete arch truss bridge. Plans with Bowman & Connor, 31 Queen St. W., Toronto.

Notre Dame des Laurentides, P.Q.—Engineers of Good Roads Commission, Quebec, are preparing estimates of new bridge for the municipality. Either concrete or wood construction.

Ottawa, Ont.—City Council plans construction of Tarvia macadam on Wilbros St., from Nicholas to Charlotte. City clerk, N. H. H. Lett.

+—Quebec, Province of.—Provincial Highway Department let contract to the PROVINCIAL BUILDING AND ENGINEERING CO., 84 Craig St. West, Montreal, for roadway.

Sarnia Tp., Ont.—Township plans building three miles of road on lake shore. Engineer, J. A. Baird, Sarnia.

+—St. Alexis de Grande Baie, Que.—City Council let contract to the PROVINCIAL BUILDING AND ENGINEERING CO., 83 Craig St. West, Montreal, for $15,000 steel highway bridge with concrete abutment.

+—St. Alphonse de Bagotville, Que.—Town council let contract to the PROVINCIAL BUILDING AND ENGINEERING CO., 83 Craig St. West, Montreal, for building macadam roads. Estimated cost, $39,000. Engineer, J. E. Grennon, Chicoutimi.

+—St. Dominique du Jonquieres, Que.—Municipal Council let contract to the PROVINCIAL BUILDING AND ENGINEERING CO., Montreal, for macadam highway, costing $40,000.

St. Dominique de Jonquieres, Que.—Work will start soon on three miles of gravel roads, costing $20,000, for the Municipal Council. Engineer, J. E. Grennon, Chicoutimi.

+—St. Remi, Que.—COLLETTE & FILS have been awarded the contract by Municipal Council for concrete and steel bridge.

+—Three Rivers, Que.—Contract has been awarded by the city for concrete pavement on St. Maurice St. to DALAIRE & POTHIER, Three Rivers. Width, 24 feet; mixture, 1 : 2 : 4.

Toronto, Ont.—Board of Control considering widening of the Kingston Road, between Silver Birch and Willow Ave.

+—Toronto, Ont.—WETTLAUFER BROS., LTD., Toronto, have sold the traction paving mixer which they exhibited at the Canadian National Exhibition to the Queen City Paving Co., Toronto, to be used for the paving work at New Hamburg, Ont. This mixer is driven by an engine which uses either gasoline or kerosene.

Verdun, Que.—Ratepayers requested City Council to propose a by-law to provide for the widening and permanent paving work on several streets. City Engineer, A. S. Clarson.

Windsor, Ont.—By-law passed providing for the widening of the alley next the river, running between Ouellette and Ferry. Estimated cost, $13,920. City clerk, M. A. Dickinson.

+—Windsor, Ont.—Contract let to the SHERWOOD CONSTRUCTION CO., LIMITED, Mail Building, Toronto, for $30,000 reinforced concrete viaduct for the Canadian Pacific Railway.

Woodworth, Man.—Tenders will be received by W. V. Stevenson, Secretary-treasurer, Harding, Man., up to September 10th, 1917, for the grading of two miles of main road in the municipality of Woodworth.

WATER, SEWAGE AND REFUSE

+—Belleville, Ont.—An order for a 125 h.p. motor-driven De Laval two-stage pump has been received from the city by the TURBINE EQUIPMENT CO., LIMITED, Toronto, this being the fourth De Laval unit purchased by this city.

+—Blenheim, Ont.—The Pere Marquette Railway, St. Thomas, Ont., let the contract for a steel tank and a reservoir to MR. MITCHELL, care of Superintendent R. S. Black, St. Thomas.

Delta, B.C.—Council will spend $1,500 on improvements to water system. Engineer, H. M. Burwell, Vancouver.