Trump Turbines

WALTER H. SAWYER

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Catalogue

of the

Celebrated Trump Turbine

HEAD GATES
TRASH RACKS
GATE VALVES
RIVETED STEEL PIPING
SLUICE GATES
STEEL HARNESS

FOR LOW AND MEDIUM HEADS

SHAFTING
GEARING
PULLEYS
FLOOR STANDS
JOURNAL BOXES
ETC.

— ALSO —

The Trump Scroll Type

FOR HIGH HEADS OR HEADS RANGING FROM 50 TO 300 FEET

— BUILT BY —

THE TRUMP MANUFACTURING COMPANY

SPRINGFIELD, OHIO, U. S. A.

IN offering this book to our patrons we have endeavored to print only what we thought would be of interest to persons owning or developing water-power, having omitted much that is usually seen in a book of this kind.

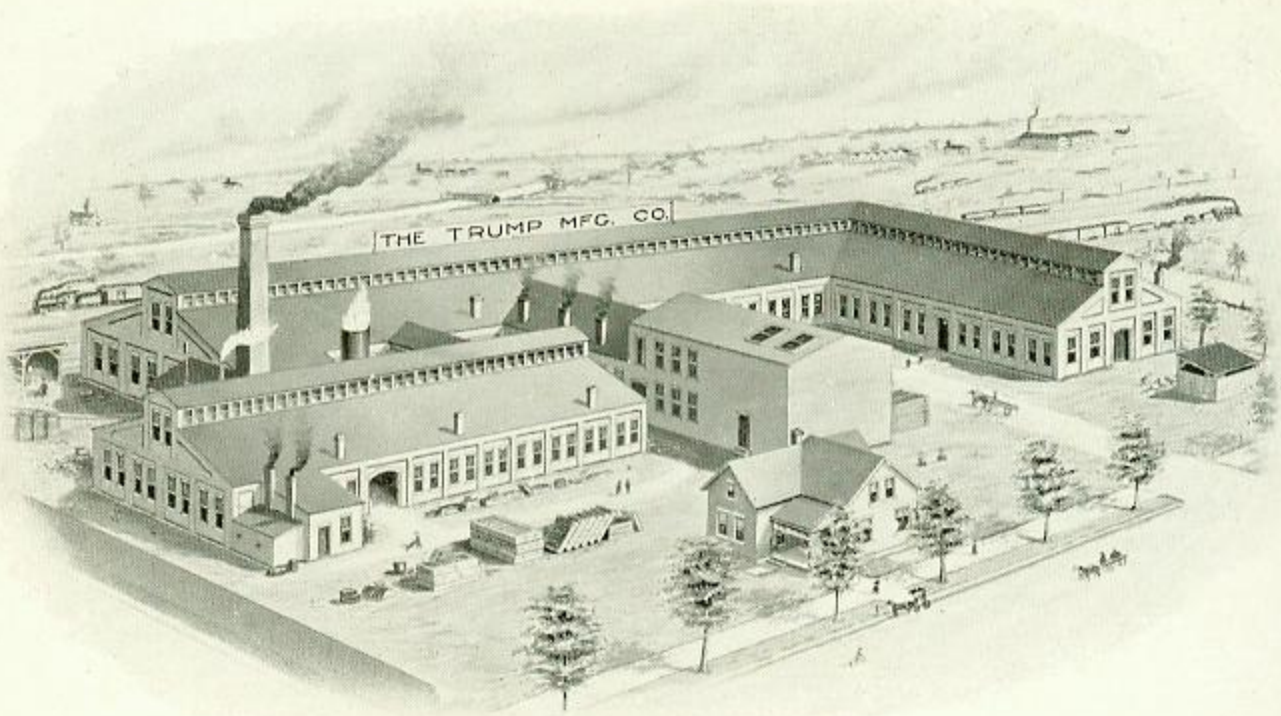
On opposite page we show cut of our works, devoted exclusively to the manufacture of the Trump Turbine and Transmitting Machinery. We build many sizes which we do not table, for either high or low heads, and adapted to suit every condition under which Turbines are used.

Nell'offrire questo catalogo alla nostra clientela abbiamo procurato di stampare soltanto ciò che noi crediamo possa interessare le persone che posseggono o cercano di sfruttare forze idrauliche, ed abbiamo ommesso molto di quanto generalmente si trova in pubblicazioni di questo genere. Le nostre officine illustrate sulla pagina dirimpetto, sono dedicate esclusivamente alla costruzione di turbine Trump e di organi di trasmissione. Fabbrichiamo inoltre molti altri modelli di turbine, per alte e basse cadute, che non sono indicate nelle nostre tabelle, ma che si prestano pressochè per qualsiasi condizione, in cui una turbina può essere collocata. Preghiamo chi ci scrive d'indicare sempre la caduta disponibile e la forza richiesta, e, se si vuole accoppiare la turbina direttamente a qualche macchina, preghiamo indicarci la velocità che si desidera.

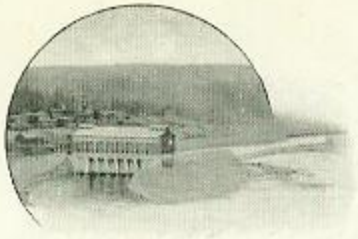
Vi hafva försökt att framställa i denna bok, endast hvad vi tänkt oss kunna vara af intresse för egare och användare af vattenkraft, och hafva uteslutet mycket, som vanligen förefinnes i böcker af detta slag.

På motsatta sidan synes vår fabriksanläggning, hvarest endast tillverkas Trumps turbiner och transmissioner. Vi bygga flera storlekar för såväl höga som låga fall, hvilka kunna användas hvarhelst turbiner kunnna placeras, förutom de i tabellerna uppgifna.

Vid förfrågningar bör fallets höjd och den erforderliga kraften uppgifvas, äfvensä hastigheten, om turbinen är direkt kopplad.



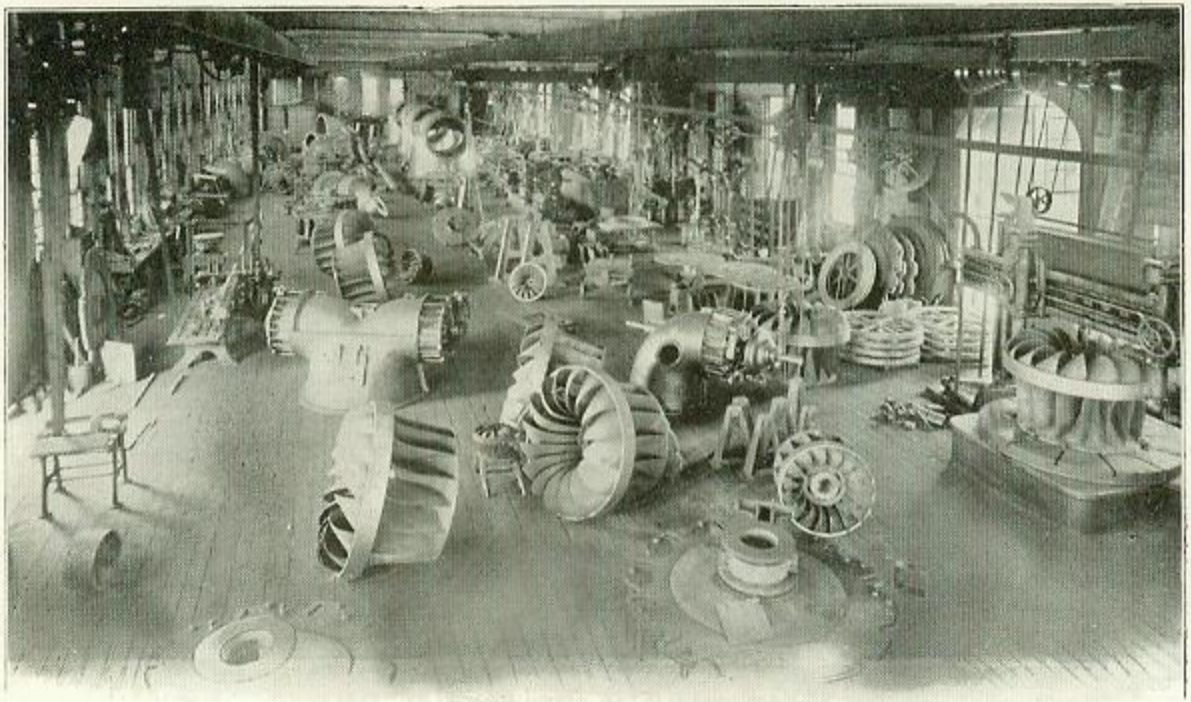
Bird's eye View of Our Works



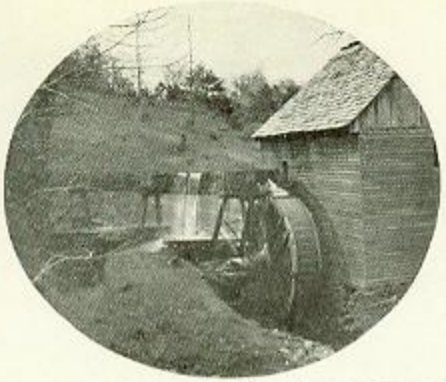
WE have a large foreign trade and have never advertised in any foreign country to any extent, having depended upon the sale of one wheel to make the sale of another and have had wonderful success. We print cuts of some foreign plants run by Trump wheels. We have received a great many photos of plants from various parts of the world which we regret to say, owing to lack of space we are unable to publish. In some of the plants shown we have as high as 14 wheels in use. Hence our patrons will understand why we have printed this book in three languages. We do not print testimonials, but prefer to refer you direct to parties using our goods.

Richiamiamo l'attenzione dei nostri cortesi lettori sulle illustrazioni di molini e stabilimenti in varie parti del mondo, in cui sono impiegate turbine Trump. Per la nostra clientela estera quotiamo i prezzi per merce resa franco bordo New York, e ci faremo un piacere di rispondere ad ogni domanda e di fornire disegni delle turbine che noi potremo raccomandare come più adatte alle condizioni speciali designate dai nostri clienti. Preghiamo indicare sempre l'altezza (in piedi o in metri) del salto disponibile, nonchè la forza che si richiede, e, nel passarci ordini, di precisare se si desidera la turbina girante a destra od a sinistra.

Vi hafva en stor afsättning i utlandet och hafva aldrig annonserat där synnerligen mycket. Vi lita på att en förnöjd köpare rekommenderar oss till en annan. Detta är hela hemligheten af vår förundransvärda framgång. Vi reproducera några utländska anläggningar, drifna af Trumps turbiner. Vi hafva mottagit många fotografier af sådana anläggningar från olika delar af verlden, men sorgligt nog äro vi ur stånd att här återgifva alla. I somliga af de här framställda anläggningarna finnas till och med 14 af våra turbiner.



View of Our Erecting Floor



ON opposite page we show two cuts of the Trump Wheel, one a Standard Wheel and the other supplied with our Improved Water Cushion, intended to support a heavy weight on top of wheel shaft, or to carry the wheel under a high head without step. This is the only device made that will carry a heavy pressure without wear or friction.

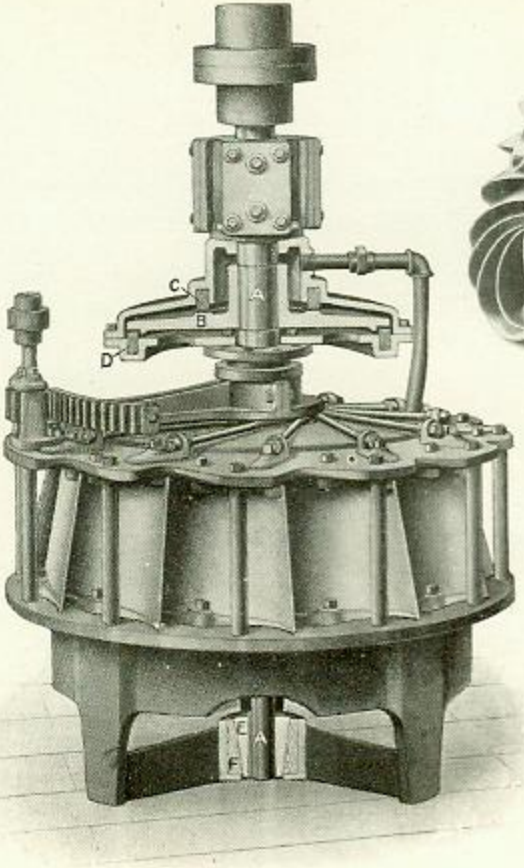
We also wish to call your special attention to the shape of our Runner, which is unequalled for low heads; and when placed horizontally will give better results than any Runner on the market.

The style gate used on the Trump wheel has been in use for many years, and will outwear any Cylinder gate built, giving a high efficiency especially at part gate. They work easily and are therefore readily controlled with Governor.

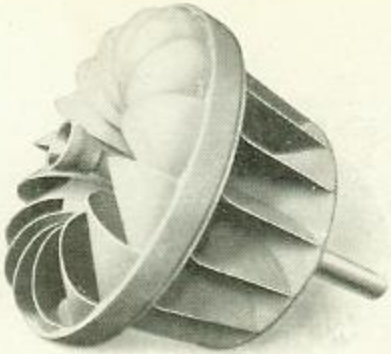
Sulla pagina qui contro riproduciamo due incisioni della turbina Trump. Una del modello comune, l'altra munita del nostro perfezionato perno equilibratore cuscinetto d'acqua, il quale è stato studiato per equilibrare una considerevole caduta d'acqua ed un peso all'estremità dell'albero della turbina verticale o per equilibrare la spinta laterale di una turbina orizzontale. Il congegno è automatico e agisce da sè sotto qualsiasi variabile condizione. Noi siamo gli unici costruttori di un congegno di tal genere automatico e senza attriti.

På motsatta sidan visa vi två afbildningar af Trumps turbiner, den ena en vanlig turbin och den andra försedd med vår vatten-fjädring, afsedd att uppbära en större tyngd på axeln eller att uppbära hjulet under högt fall utan dubb. Denna anordning är enda sättet att uppbära tunga vigter utan nötning eller friktion. Vårt krafthjul är oöfverträffadt för lågt fall. Det gifver bättre resultat än något hjul i marknaden, när det placeras horisontalt.

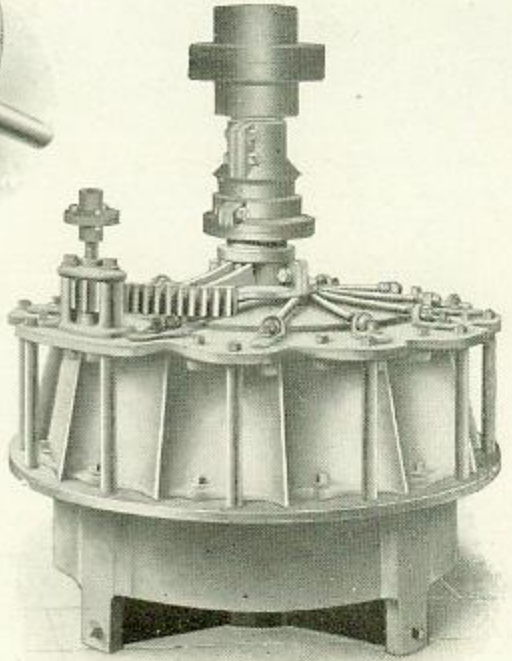
Pådraget, som användes för Trumps turbiner, har varit i bruk i många år. De hålla längre än något cylindriskt pådrag och gifva högre verkningsgrad, särskildt vid delvist pådrag. De opereras lätt och äro derför lätt påverkade af regulatorn.



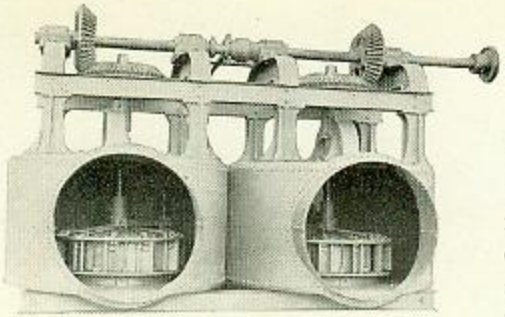
Turbine with Water Cushion



Trump Runner



Standard Trump Turbine



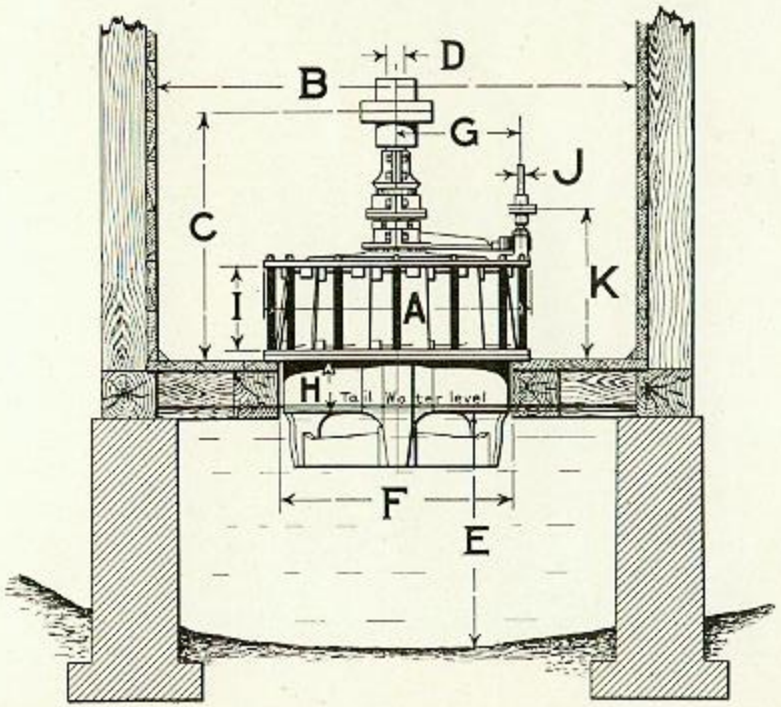
DRAFT or suction tubes can be used to an advantage in many locations, but usually should not be over twenty-five feet in length. They must be carefully made so as to be perfectly air-tight, should be larger in diameter at the discharge end and of sufficient length to extend below the surface of the standing tail water several inches, so as not to admit any air at the lowest stage of water. The efficiency of a Turbine is often increased by the use a draft tube but should be set vertically if possible. Tubes set at an angle do not give as good results as if placed vertically.

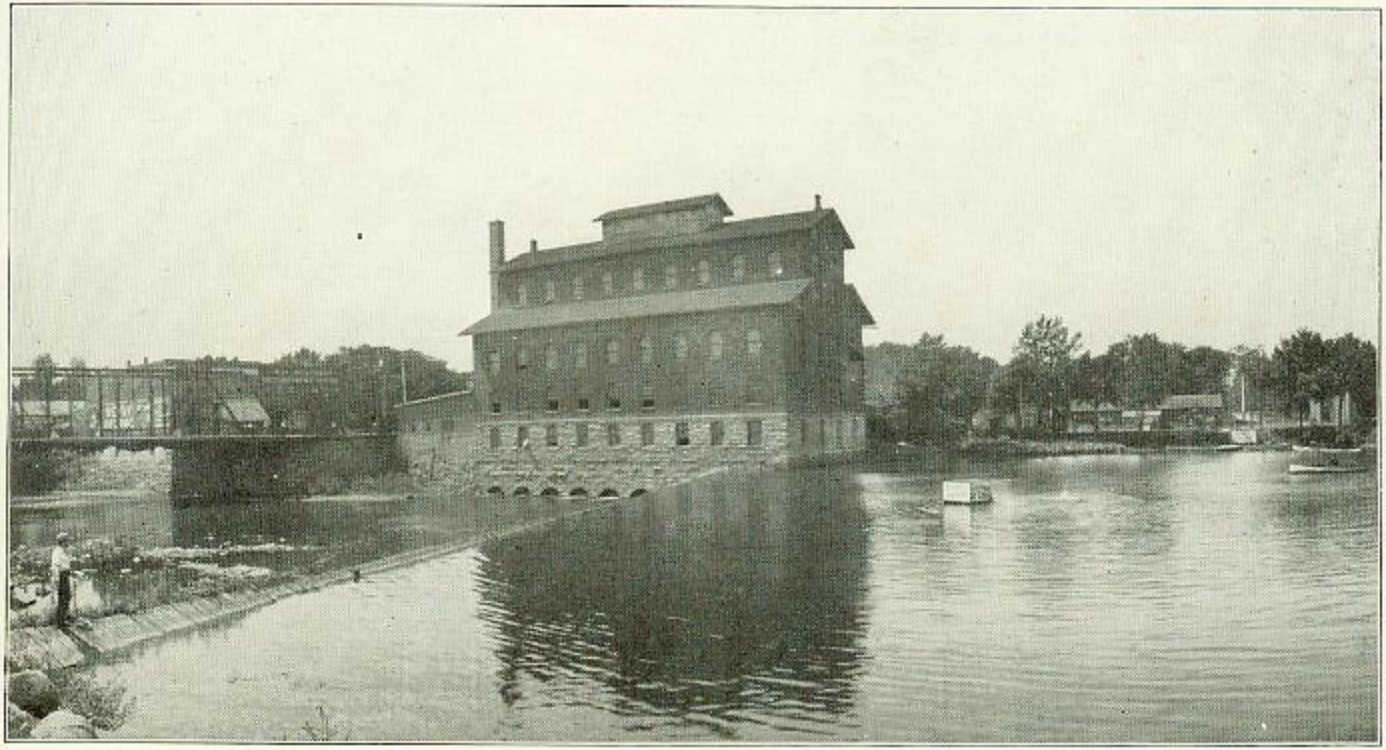
In molti casi è desiderabile di collocare la turbina ad una certa altezza al disopra del pelo d'acqua del canale di scarico. In tali casi il tubo di aspirazione deve prolungarsi alquanto sotto il pelo d'acqua di scarico. I tubi di aspirazione non devono esser lunghi più di 8 metri e l'estremità immersa nel canale di scarico dev'essere più larga di quella d'attacco alla turbina. Non c'è perdita di forza nell'impiegare tubo di aspirazione e in molti casi ciò riesce di vantaggio, utilizzandosi tutta la forza disponibile anche quando havvi un rigurgito nel canale di scarico per effetto di inondazione. I tubi devono però essere assolutamente a perfetta tenuta d'aria.

Sugtrummor kunna användas med fördel vid många tillfällen, ehuru man måste hålla dem fullständigt lufttäta. De böra ej vara öfver 25 fot (=7. 5 m) långa, och böra nedsättas 4 eller 5 tum (=125 mm) under afloppsvattnets yta. Vid många tillfällen är en sugtrumma lämplig, särskildt när afloppskanalen är grund. Koniska rör, som äro större vid afloppsdelen, öka betydligt turbinens verkningsgrad. Är sålunda afloppskanalen grund, bör turbinen sättas högt och ett koniskt sugrör användas.

Jokkis Gods Aktiebolag, Finland

Diameter of Wheel	A Diameter of Wheel Casing over all.	B Internal Diameter of Pen-stock	C Length of shaft from floor to Center of Wheel Coupling	D Bore of Upper half Coupling	E Depth of Water under Wheel	F Diameter of hole in bottom of Pen-stock	G Distance from Center of shaft to Center of Gate-rod	H Depth of Cylinder below floor	I Width of Gates	J Size of Gate Shaft	K Distance from floor to Center of Gate. Shaft Coupling
14 in.	26 in.	52 in.	30 in.	2¼ in.	3 in.	22½ in.	11⅜ in.	6 in.	7 in.	1 in.	16½ in.
17 "	30 "	56 "	34 "	2⅜ "	3⅛ "	26½ "	12⅝ "	6½ "	8½ "	1⅛ "	18 "
20 "	35 "	60 "	37 "	2½ "	3½ "	31 "	15⅛ "	7 "	10 "	1⅛ "	21 "
23 "	39 "	66 "	39 "	2⅝ "	4 "	35 "	16⅝ "	9 "	11½ "	1¼ "	23 "
26 "	44 "	72 "	42 "	3 "	4 "	38 "	19⅛ "	10 "	13⅛ "	1¼ "	25 "
30 "	50 "	78 "	48 "	3½ "	4½ "	44 "	22⅛ "	10 "	15½ "	1⅜ "	27½ "
35 "	58 "	108 "	54 "	3⅝ "	4½ "	50 "	25½ "	12 "	17⅝ "	1½ "	31 "
40 "	65 "	112 "	58 "	4 "	5 "	57 "	27½ "	13 "	20 "	1½ "	34 "
44 "	70 "	120 "	64 "	4 "	5 "	61 "	32½ "	15 "	22 "	1⅝ "	40 "
48 "	77 "	150 "	69 "	4½ "	5½ "	67 "	35 "	13 "	24 "	1⅞ "	43 "
52 "	84 "	156 "	73 "	5 "	5⅝ "	71 "	37⅝ "	13 "	26 "	1⅞ "	46 "
56 "	90 "	162 "	78 "	5½ "	6 "	79 "	40½ "	13 "	28 "	1⅞ "	48½ "
61 "	97 "	172 "	81 "	6 "	6 "	84 "	44½ "	12½ "	30 "	2 "	52 "
66 "	105 "	196 "	90 "	6½ "	6½ "	90 "	48⅝ "	12½ "	33 "	2⅛ "	56 "





Electric Power Station, Independence, Iowa

THE Wier Table shows the amount of water that will pass through a Weir board per minute. The cut gives a general idea of a Weir board and manner of measuring water. The stake, E, should be carefully leveled with the top of the stake level with the notch. The table shows the number of cubic feet passing for each inch or fraction inch in depth, and for one inch in width.

EXAMPLE.—Say notch is 24 inches wide, and water measures 6 inches from top of stake. Table shows that for each inch in width the flow will be 5.60 cubic feet, or for 24 inches width 134.4 cubic feet.

La figura qui contro insegna il modo di misurare la portata di piccoli corsi d'acqua e la tabella indica quanti piedi cubi d'acqua passano al secondo attraverso ad una bocca a stramazzo.

Esempio: Supponiamo che la bocca a stramazzo sia larga 40 pollici (misura inglese) e la profondità dell'acqua dalla sommità del palo sia di 6 pollici. Facendo uso della tabella si vedrà che con 6 piedi di profondità (o altezza) d'acqua passeranno 5,60 piedi cubi per ogni pollice di larghezza della bocca, d'onde per 40 pollici di larghezza passeranno 5,60 x 40=224 piedi cubi d'acqua. La sommità del palo E deve trovarsi a livello della soglia dello stramazzo e all'incirca un metro a monte della diga come rappresenta la figura.

Weirs tabell på motsatta sidan visar huru mycket vatten passerar genom en fördämning af en viss storlek. Afbildningen gifver en allmän idé af tillvägagåendet. Staken E bör plaseras så att dess top är i jämnhöjd med tröskeln. Tabellen uppgifver huru många kubikfot passera för ett visst djup och för en bredd af en tum.

Ex. Är fördämningen 24" bred och vattnets höjd öfver staken 6", visar tabellen ett flöde af 5.6 kubik fot för hvarje tums bredd, eller för 24" bredd 134.4 kubik fot.

MANNER OF MEASURING WATER WITH WIER.

(SEE OPPOSITE PAGE)

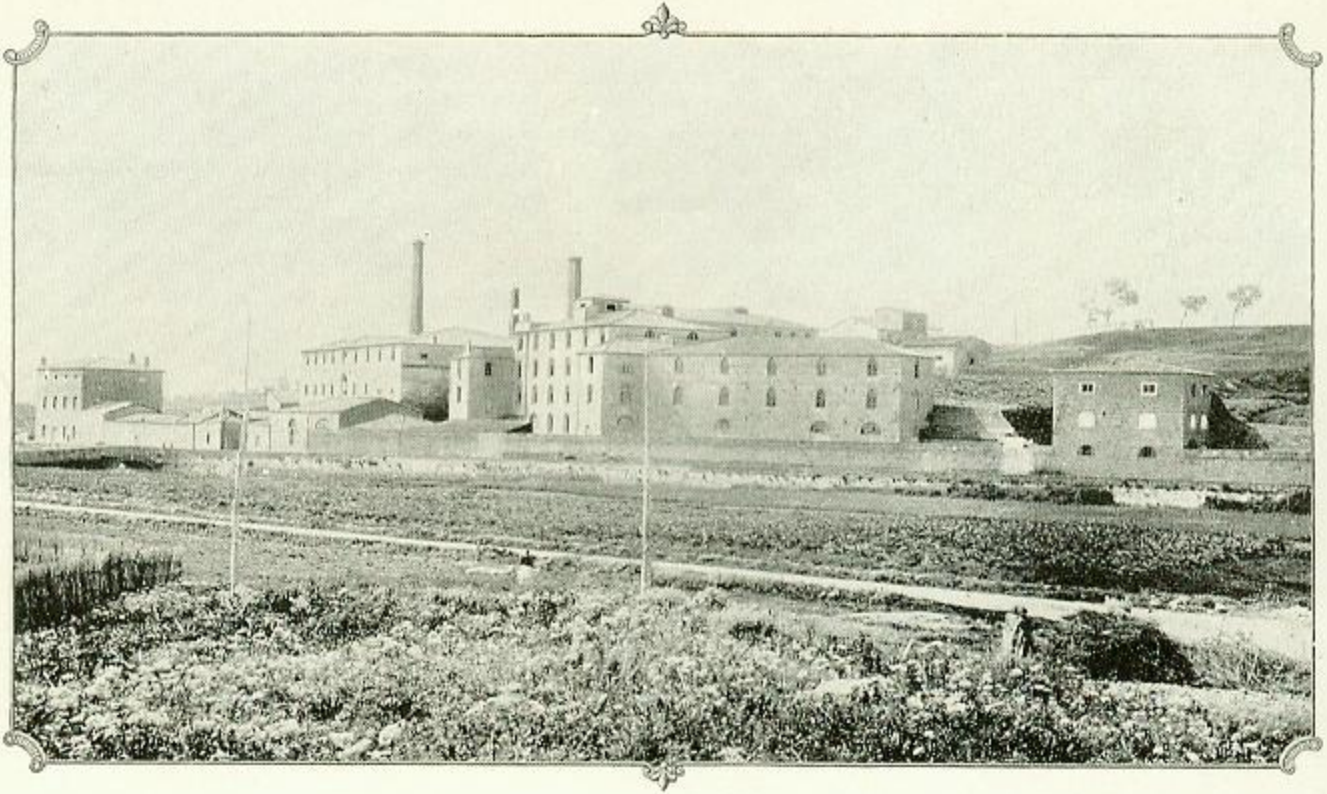
INCHES.		1/8	1/4	3/8	1/2	5/8	3/4	7/8
		.01	.05	.09	14	20	26	33
1	.40	.47	.55	.65	.74	.83	93	1.03
2	1.14	1.14	1.36	1.47	1.59	1.71	1 83	1.96
3	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5	3.50	4 67	4.84	5.01	5.18	5.36	5.54	5.72
6	5.60	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7	7.41	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10	12.71	12.95	13.19	13.43	13.67	13.93	14.16	14.42
11	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13	18.87	19.14	19 42	19.69	19.97	20.24	20.52	20.80
14	21.00	21.37	21.65	21.94	22.22	22.51	22.79	23.08
15	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96

PUT in a good turbine at the start even if it costs a few dollars more than a poorer one. A second class turbine is dear at any price. No owner of water power at the present day can afford to put in an inferior wheel. Power is more valuable today than it was 20 years ago and there is a ready market for all the power that can be supplied; at the same time the average volume of water in streams during the summer months is less than formerly. So in order to get all the power possible it is necessary to use a good turbine.

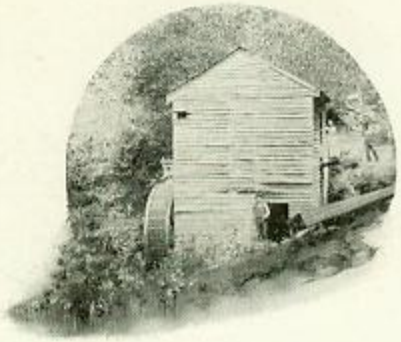
Per spedizioni marittime all'estero nulla addebitiamo per imballo in gabbie, a meno che le turbine siano smontate, nel qual caso, fatturiamo il costo reale dell'imballaggio. Ordinariamente non occorre smontare le turbine per l'imbarco, a meno che siano di dimensione più grande di 35". Le turbine orizzontali, di regola, devono essere smontate per l'imbarco, pel che facciamo un leggero addebito addizionale per coprirci unicamente del costo reale dell'imballaggio.

Le nostre turbine sono costrutte robuste in ogni parte e non vi è pericolo che qualche organo si rompa o causi delle noie, quando viene convenientemente montato.

Uppsätt aldrig annat än en god turbin, äfven om den skulle vara något dyrare än en dålig. En dålig turbin är dyr till hvad pris som helst. Vattenkraft är mera värdefull nu för tiden än för en tjugo år sedan, och det finnes bruk för all den kraft, som kan erhållas. Dessutom är vattenmängden i floderna under sommarmånaderna mindre än förr. För att sålunda erhålla så mycken kraft som möjligt, bör man använda en god turbin.



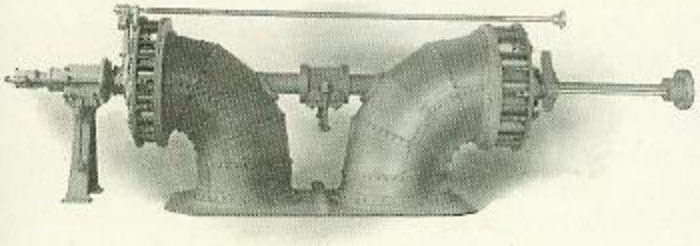
Plant of Gustavo Corrido, Livorno, Italy



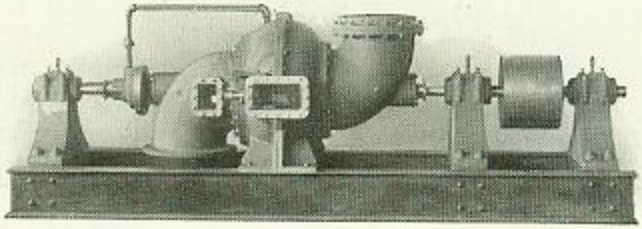
THE life of a good turbine under an ordinary head is about 25 years. The efficiency is much less however after the turbine has been in use 10 or 12 years. Every wheel should be overhauled and examined at least once a year so as to see that it is kept tight and there is no waste of water. All runners should be carefully balanced so that they run true in the case, if not they soon wear the sides of the casing and oftentimes waste from 10 to 20 per cent. of the water passing through the gates. As a rule a turbine is considered healthy as long as it continues to revolve. No other machine gets as little care.

Per alte cadute e per scopi speciali occorre generalmente costrurre in ogni caso una turbina atta ad agire ad una velocità prefissa e sotto una data caduta, specialmente quando trattisi di azionare dei Generatori elettrici, e, in genere, qualsiasi altra macchina con accoppiamento diretto. Vi è sempre una certa velocità che una turbina dovrebbe mantenere per dare il suo massimo rendimento. Se la turbina aumenta o diminuisce la velocità per la quale fu costrutta, vi sarà perdita di forza e di rendimento. È nostra specialità di fornire turbine speciali per velocità prescritte adatte alle varie condizioni.

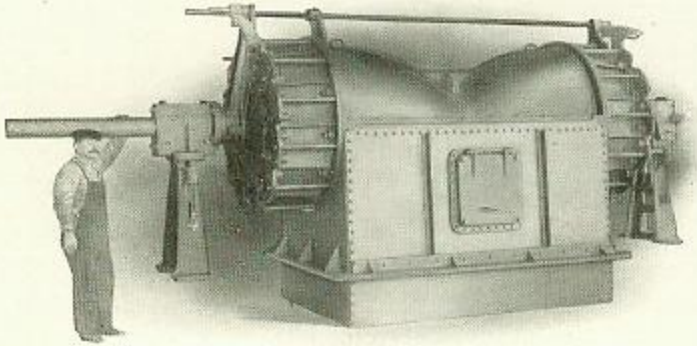
En god turbin varar under medelhöga fall ungefär 25 år. Dock förminskas verkningsgraden betydligt, sedan turbinen användts i tio eller tolf år. Hvarje turbin bör noga undersökas åtminstone en gång om året, för att vara säker på att den är tät och att ingen förlust af vatten försigkommer. Krafthjulet bör omsorgsfullt balanseras, så att det löper rätt i turbinhuset och ej nöter på sidorna.



Independent Draft Chest Type, Same Speed But Different Capacities



Small High Head Type



Low Head Draft Chest Type

DURING the past 20 years turbines of the horizontal style have come into general use; previous to that time almost all turbines installed were of the vertical type. The fact is, a vertical turbine will give a higher efficiency than one placed horizontally, but when you transmit the power through bevel gearing the loss is much greater than the difference in efficiency between the vertical and horizontal style. Under low heads, however, it is necessary to use vertical turbines, as the conditions are usually such that it is impractical to use a horizontal one. Where a small amount of power is required under a high head, it is economy to use a vertical turbine and transmit the power with quarter-twist belt

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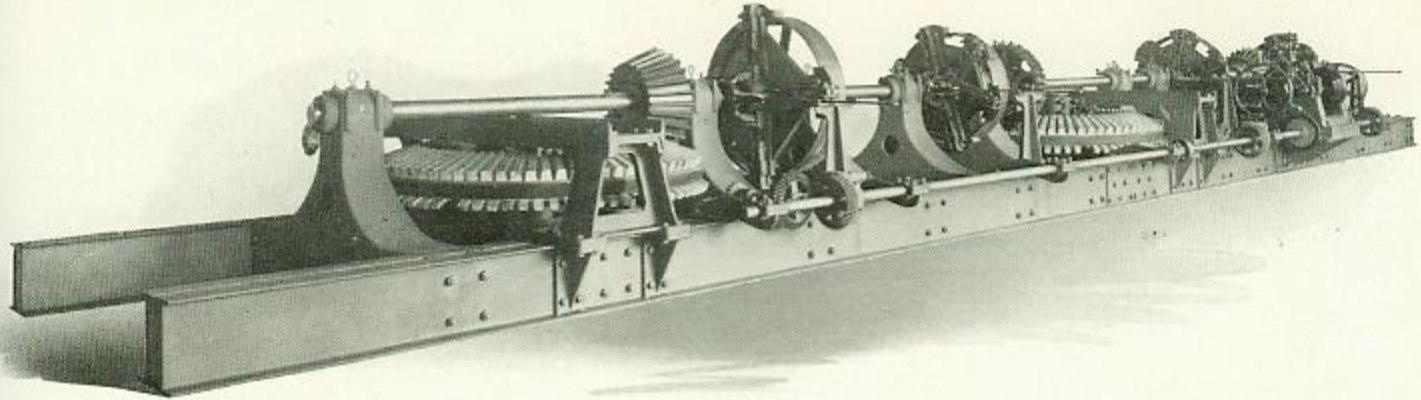
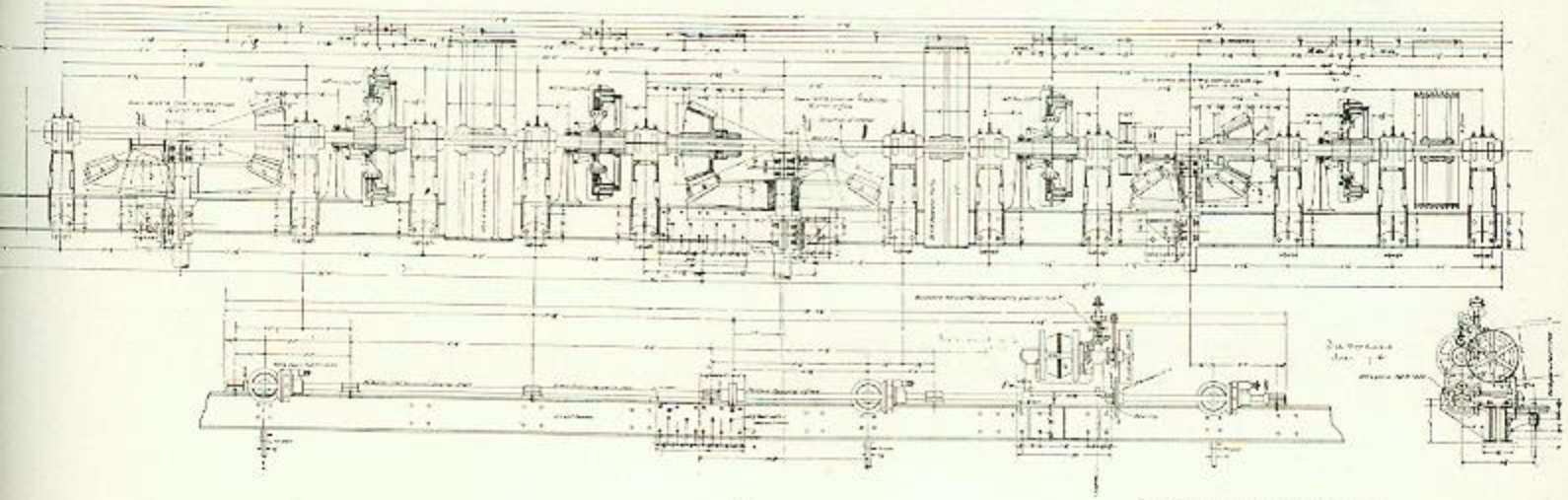
Spesso è desiderabile conoscere quale forza potrà sviluppare una turbina sotto una caduta maggiore di quella indicata nella tabella. La seguente regola è applicabile a qualunque tipo di turbina: 4 volte la caduta dà 8 volte la forza usando doppio volume d'acqua e raddopiando il numero di giri per minuto.

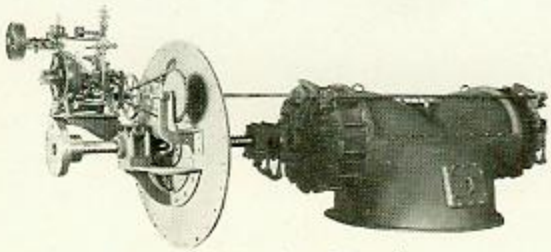
Esempio: Quale forza darà la nostra turbina di 30" sotto 16 metri di caduta? Riferendoci alla tabella vediamo che questa turbina sotto $\frac{1}{4}$ di 16 metri, cioè sotto 4 metri di caduta dà 100, 6 HP smaltendo 2386 litri d'acqua per secondo ad una velocità di 159 giri al l'. Dunque sotto 16 metri di caduta questa turbina darà 8 volte la forza, cioè 804, 8 HP, smaltendo 4772 litri per secondo alla velocità di 318 giri.

Under de senaste tjugo åren hafva horisontala turbiner kommit mer och mer i bruk. Före denna tid voro nästan alla turbiner af den vertikala typen. Faktum är, att en vertikal turbin gifver större verkningsgrad än en horisontal. Men öfverför man kraften genom kugghjul, blifver förlusten större än skilnaden i verkningsgraden mellan den vertikala och den horisontala typen.





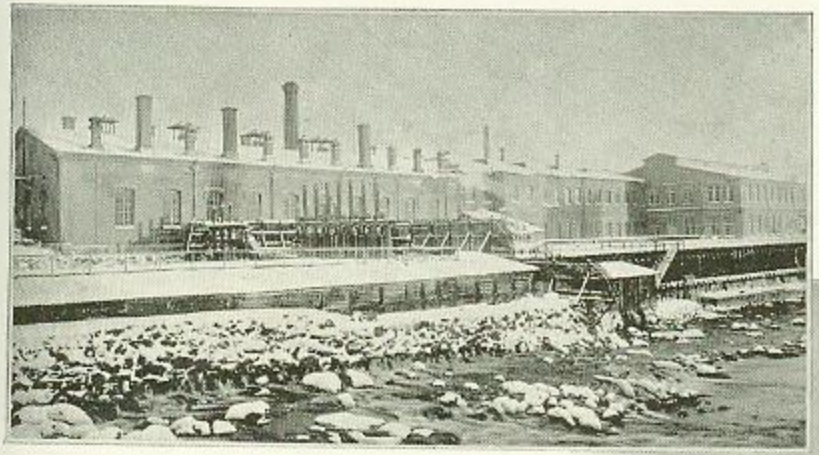
Our Type of Harness and Gearing

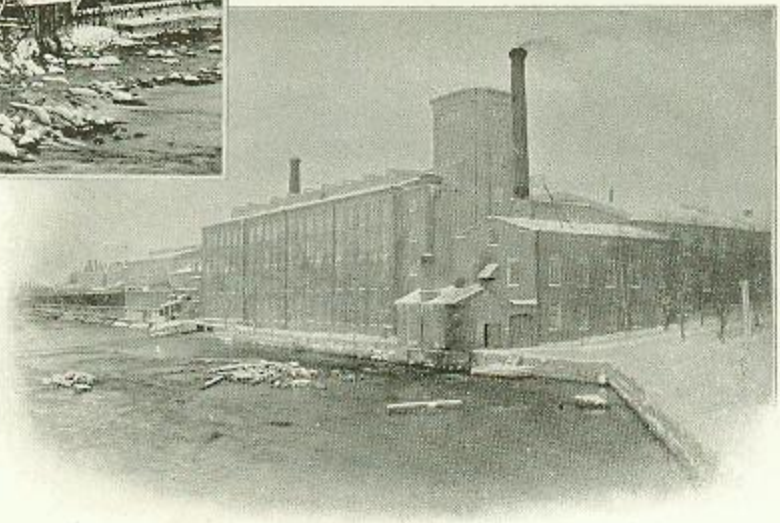


WE AIM to keep our turbines up to date in every particular, as well as appliances connected with the development of water power. Our specialties are all new; we offer no old style or antiquated devices to our customers and our harness, bridgetrees, journal box patterns, etc., are always of the latest design. Our relief and gate valves, hoisting gearing, wicket valves, etc., are excelled by none. We do not build small relief valves—nothing smaller than 24 inches nor larger than 48 inches in diameter. If you wish any specialty connected with the development of water power, write us, describing what you wish, and we will submit plans for your approval.

La robustezza è uno dei più importanti requisiti di una turbina, specialmente pei nostri clienti in paesi esteri; perciò noi dovremmo sempre essere informati riguardo alla caduta sotto cui la turbina deve funzionare. Per alte cadute i distributori, segmento, pignone e collegamenti del distributore sono di bronzo. Le ruote giranti delle nostre turbine, tanto per alte come per basse cadute, sono costrutte colle pale di acciaio fucinato, e sosteniamo che questa costruzione è la migliore. Le pale di ghisa impiegate ordinariamente sono fragili e quando avviene che se ne rompa una, questa generalmente cagiona la rottura di molte altre.

Vi bemöda oss att göra våra turbiner fullt moderna i alla detaljer. Inga gammalmodiga konstruktioner förefinnas. Alla våra tillverkningar för att tillgodogöra vattenkraft äro konstruerade efter de nyaste ideer. Våra säkerhets—och pådrags—ventiler, pådragsanordningar, etc., äro förträffliga. Vi tillverka inga små säkerhets-ventiler, inga mindre än 24 tum, och inga större än 48 tum i diameter.





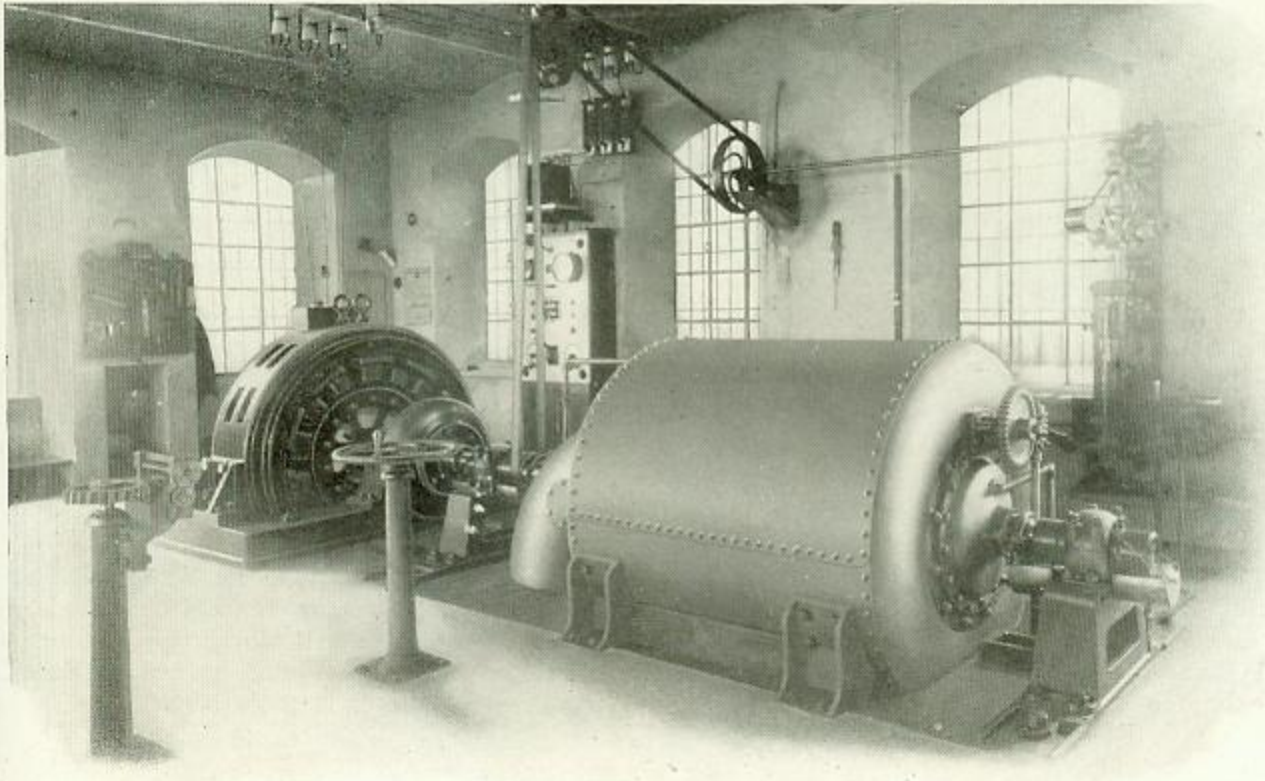
Tammerfors Linne & Jerntmanufaktur A. B. Finland

ONE of the most difficult parts to replace on a turbine is the step or pivot on which the runner revolves. Under a low head, steps give but little trouble on any turbine, under heads of 20 feet and over they give more or less trouble, but under higher heads unless an extra thrust bearing is used much trouble is caused, especially when heavy gearing is carried on top of turbine shaft. We build two styles of Water Cushions, one for low or medium heads, the other for high heads. Low head cushions carry three-fourths of the weight; high head cushions carry all the weight without the use of a central step.

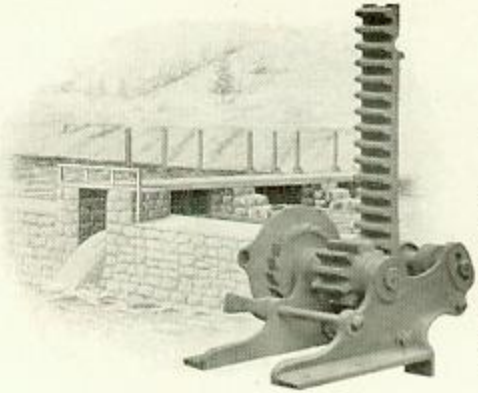
Write us for particulars.

Uno degli organi che spesso causano gravi inconvenienti in una turbina, sotto un'alta caduta è il perno d'appoggio in legno duro o perno di sospensione che sostiene la girante: il rinnovo di questo perno di legno causa molta spesa, interruzioni di lavoro, e disturbi, i quali vengono evitati coll'uso del nostro perfezionato cuscinetto d'acqua, o congegno di equilibrio brevettato, il quale sopporta il peso senza usura o frizione, e, sotto alte cadute, elimina completamente l'impiego del perno di legno. Sotto basse cadute il perno d'appoggio in legno, non dà luogo a inconvenienti gravi, perchè la pressione dell'acqua non è sufficiente per causare un'usura eccessiva.

En af de svåraste delarna i en turbin att ombyta är tappen, på hvilken krafthjulet löper. Under lågt fall gifver denna blott föga besvär i hvilka som helst turbiner, men för fall af 15 fot och derutöfver förefinnes alltid mer eller mindre olägenhet genom nötning, särskildt när tunga kugghjul uppbäras af turbinaxeln. Vi bygga två slags vattenfjädringar, en för låga och medelhöga fall och en för höga fall.



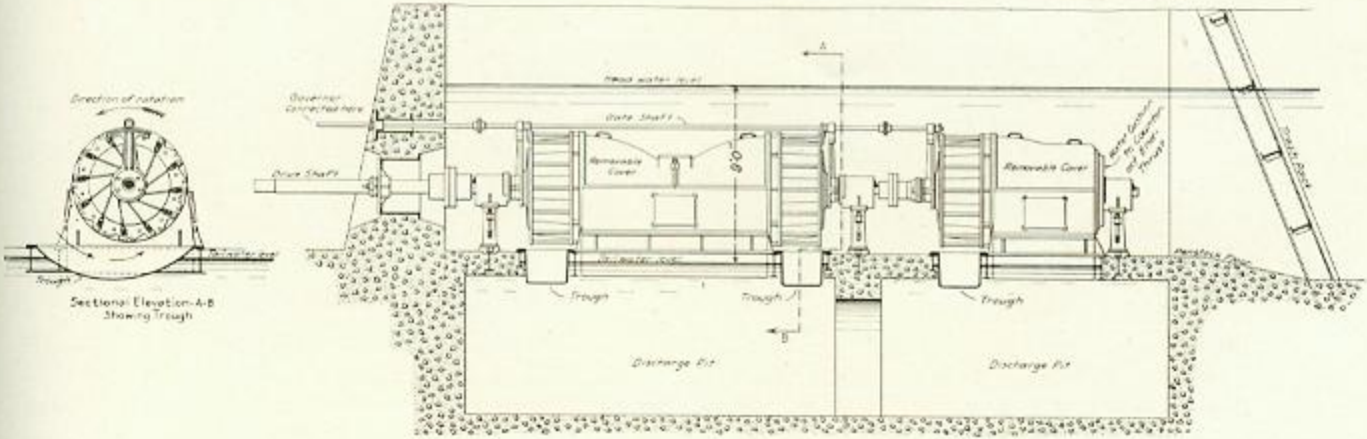
Electric Station, Biella, Italy



WHERE wheels are placed under high heads and the water carried in a long pipe, a relief-valve should be used to take care of any sudden increase of pressure. Sometimes air-chambers are used but they are not reliable. The relief-valve should be constructed of sufficient capacity to allow water enough to escape instantly, so as to relieve any sudden strain on piping or wheel casing and should be designed so that it can be closed quickly, so as to waste as little water as possible. We build Valves for this purpose which are carefully tested to the required pressure.

Pei nostri clienti esteri possiamo segnare i prezzi per merce resa franco bordo vapore nel porto di mare più prossimo al luogo di destinazione. Per le turbine che dobbiamo spedire franche a destino, richiediamo sempre ½ dell'importo anticipato, siccome dobbiamo sborsare in precedenza il nolo transoceanico. Tuttavia le tariffe marittime sono molto basse. Salvo prescrizioni contrarie, tutte le spedizioni per l'estero sono da noi consegnate franco bordo vapore New York.

När turbiner äro plaserade under högt fall och vattnet föres i en lång sprängtrumma, bör en säkerhetsventil användas för att utjämna en allt för hastig ökning af trycket. Stundom användas luftklockor, men de äro icke pålitliga. Säkerhetsventilen bör vara konstruerad tillräckligt stor för att tillåta nog vatten att ögonblickligen afgå, men bör samtidigt vara så konstruerad att den stänges fort, och ej ödar för mycket med vattnet.



44-inch Low Head Draft Chest Type

OUR Wheels are tabled at 80 per cent. efficiency and they give it; in other words, we guarantee our Wheels to give their tabled power and to be well built in every particular.

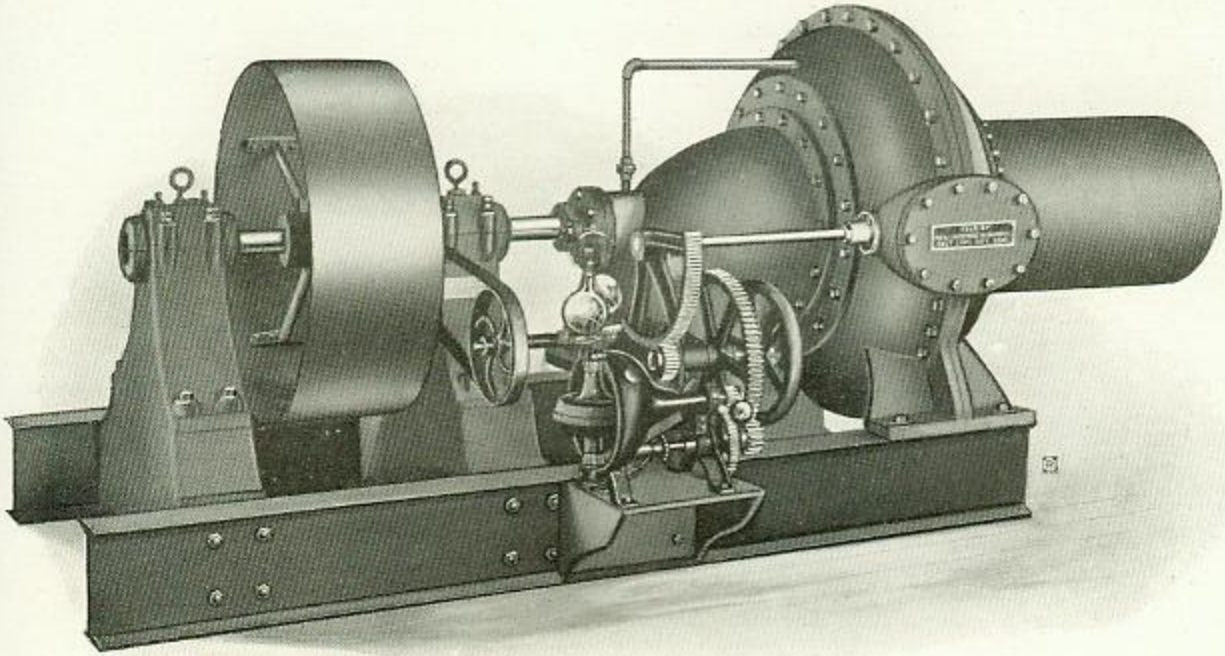
We use forged steel buckets and forged iron shafts on all sizes of Wheels.

Our High Grade Turbines are especially constructed for High Heads, having Bronze Gates, Segments, Pinions and Gate connections. We balance all Runners carefully, in fact, we claim to build the strongest and most efficient Runner on the market. We do not print testimonials but will refer you to parties using our wheels under conditions similar to yours. Write us fully giving head wheel is to be placed under and amount of power required.

Le nostre tabelle indicano la forza delle turbine calcolata in base ad un rendimento dell'80%. Tale forza noi garantiamo per tutte le nostre turbine verticali, che smaltiscono il volume d'acqua rispettivamente indicato nelle tavole. Le turbine di grande portata ad asse orizzontale dànno un rendimento del 5% inferiore a quello delle turbine verticali. Le nostre turbine orizzontali "HIGH GRADE" specialmente costrutte per alte cadute, dànno un rendimento più alto che le turbine orizzontali di grande capacità. Non vi sono turbine nè verticali, nè orizzontali che diano un maggior rendimento. Le pale, in tutte le nostre turbine, sono di acciaio fucinato.

Våra turbiner uppgifvas i tabellerna för 80 proc. verkningsgrad. Vi garantera våra turbiner att gifva den kraft tabellerna uppgifva. De äro väl byggda i alla hänseenden. Skoflarna äro af smidt stål och smidda järnaxlar användas för alla våra turbiner.

Våra bästa turbiner äro särskildt byggda för högt fall. De hafva pådrag, segment, kugghjul och pådragsländkar af brons. Vi balansera våra turbiner omsorgsfullt. Vi påstå på det bestämdaste, att vi bygga det starkaste och mest effektiva krafthjul i marknaden. Vi trycka inga intyg, men vilja hänvisa till användare af turbiner för liknande ändamål. Tillskrif oss!



Trump High Head Scroll Type Turbine with End Supply Pipe

TABLES SHOWING POWER AND SPEED OF OUR STANDARD TRUMP TURBINES.

SIZE OF WHEELS	No. Feet Head	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
14 inch	Horse Power	3.3	4.1	5.0	7.	8.4	10.1	11.7	13.6	15.5	17.5	19.6	21.7	23.9	26.2	28.9	31.1	33.5	36.	38.6
	Cubic ft. Water used per Minute	491	552	605	654	699	741	778	819	856	891	925	957	989	1019	1049	1078	1106	1132	1159
	Revolutions per Minute	192	215	236	254	272	285	304	319	333	347	360	373	385	397	408	419	430	441	451
17 inch	Horse Power	4.8	6.5	8.1	11.	13.3	15.8	18.4	21.4	24.	27.5	30.7	34.2	37.6	41.2	44.8	48.6	52.6	56.2	60.4
	Cubic ft. Water used per Minute	775	870	950	1030	1098	1163	1220	1287	1343	1400	1450	1502	1551	1601	1646	1691	1736	1777	1819
	Revolutions per Minute	158	177	194	209	224	235	250	263	274	286	296	309	317	327	336	345	354	363	372
20 inch	Horse Power	7.8	10.1	13.3	16.8	20.6	24.6	28.7	33.	37.8	42.6	47.7	52.9	58.3	63.9	69.6	75.6	81.5	87.7	94.
	Cubic ft. Water used per Minute	1392	1344	1472	1591	1701	1803	1892	1994	2082	2169	2250	2329	2406	2480	2552	2622	2691	2756	2820
	Revolutions per Minute	134	150	165	178	190	200	213	223	233	243	252	261	269	278	286	293	301	309	316
23 inch	Horse Power	9.6	13.5	17.7	22.4	27.3	32.6	38.	44.1	50.2	56.7	63.3	70.2	77.4	84.2	92.4	100.2	108.2	116.4	124.8
	Cubic ft. Water used per Minute	1596	1785	1955	2112	2258	2394	2512	2648	2765	2880	2987	3092	3195	3293	3389	3482	3573	3659	3745
	Revolutions per Minute	117	131	143	155	166	173	185	194	203	211	219	227	234	241	248	255	262	268	275
26 inch	Horse Power	12.5	17.4	22.9	28.9	35.3	42.2	49.2	57.	65.	73.9	81.9	90.8	100.	109.8	119.5	129.	140.	150.5	161.4
	Cubic ft. Water used per Minute	2064	2308	2527	2732	2920	3096	3247	3423	3575	3723	3862	3998	4131	4258	4381	4502	4619	4730	4842
	Revolutions per Minute	102	115	124	134	144	152	161	169	176	183	190	197	204	210	216	222	227	233	238
30 inch	Horse Power	16.4	22.2	30.2	38.	46.5	55.5	64.6	74.9	85.4	96.3	107.	119.	131.	144.	157.	170.	183.8	197.8	212.
	Cubic ft. Water used per Minute	2712	3032	3321	3589	3836	4068	4267	4498	4697	4892	5075	5255	5428	5594	5757	5915	6069	6215	6362
	Revolutions per Minute	89	99	109	118	125	132	140	147	154	160	166	172	177	183	189	194	199	204	209
35 inch	Horse Power	22.4	31.3	41.1	51.9	63.4	75.5	88.2	102.3	116.5	131.	146.9	162.9	179.5	196.6	214.2	232.4	250.9	269.9	289.3
	Cubic ft. Water used per Minute	3700	4138	4531	4899	5235	5551	5822	6138	6409	6675	6925	7168	7407	7634	7855	8071	8282	8481	8681
	Revolutions per Minute	77	86	94	101	109	114	121	127	133	139	144	149	154	159	163	168	172	176	180
40 inch	Horse Power	29.1	40.7	53.5	67.6	82.4	98.9	114.4	132.9	156.4	170.7	191.	211.7	232.8	255.5	278.4	302.	326.1	350.8	376.
	Cubic ft. Water used per Minute	4809	5378	5889	6365	6804	7214	7567	7977	8330	8676	9000	9317	9606	9921	10209	10490	10764	11023	11282
	Revolutions per Minute	67	75	82	89	95	100	106	111	116	121	126	130	134	139	143	147	151	154	159
44 inch	Horse Power	37.2	49.2	64.5	86.4	99.5	119.	138.7	160.8	183.2	206.5	231.	256.1	282.3	308.1	336.9	365.4	394.5	424.4	454.9
	Cubic ft. Water used per Minute	5817	6506	7104	7699	8210	8727	9154	9650	10077	10495	10887	11270	11645	12002	12350	12690	13021	13335	13648
	Revolutions per Minute	61	68	75	81	86	90	96	101	106	110	114	118	121	126	130	133	137	140	143
48 inch	Horse Power	44.9	58.6	77.	96.9	118.6	141.6	164.9	191.3	217.9	245.7	274.7	304.6	335.7	367.7	400.7	434.9	469.3	504.8	540.
	Cubic ft. Water used per Minute	6929	7738	7474	9158	9790	10380	10888	11478	11986	12483	12950	13405	13851	14276	14690	15094	15488	15861	16234
	Revolutions per Minute	56	62	68	74	79	83	88	93	97	101	105	108	112	115	119	122	125	128	131
52 inch	Horse Power	49.2	68.8	90.4	114.	139.2	166.2	193.6	224.5	255.8	288.4	322.3	357.6	394.	431.	470.3	510.	550.8	592.3	635.
	Cubic ft. Water used per Minute	8122	9083	9946	10750	11491	12184	12780	13473	14069	14652	15200	15735	16257	16756	17242	17700	18179	18616	19064
	Revolutions per Minute	51	57	63	68	73	77	82	86	89	93	97	100	103	106	110	113	116	118	121
56 inch	Horse Power	57.	80.	104.9	132.	161.6	192.8	224.6	260.5	296.8	334.7	374.2	414.9	457.3	500.8	545.7	591.8	638.8	687.5	737.
	Cubic ft. Water used per Minute	9424	10570	11541	12473	13333	14138	14829	15633	16325	17002	17637	18258	18865	19443	20007	20558	21094	21602	22110
	Revolutions per Minute	47	53	59	63	67	71	76	79	83	87	90	93	96	99	102	105	107	110	113
61 inch	Horse Power	67.5	94.4	121.	156.3	190.	228.	265.8	308.	350.	395.6	442.4	490.5	544.2	592.	645.	700.	755.5	812.7	871.
	Cubic ft. Water used per Minute	11142	12459	13644	14744	15765	16713	17539	18481	19288	20099	20850	21589	22401	22985	23650	24302	24936	25537	26137
	Revolutions per Minute	44	49	54	58	62	66	70	73	76	79	82	85	88	91	94	96	99	101	106
66 inch	Horse Power	83.2	116.4	152.9	192.9	234.9	281.2	327.6	379.9	432.6	488.	545.6	605.2	666.9	730.4	795.9	863.4	932.2	1002	1074
	Cubic feet Water used per Minute	13746	15373	16833	18192	19443	20621	21629	22802	23811	24799	25724	26639	27515	28358	29181	29985	30767	31657	32348
	Revolutions per Minute	41	46	50	54	57	61	64	68	71	73	76	79	82	84	87	89	91	94	96

We Table Our Wheels at 80 Per Cent Efficiency, and They Give It.

TABLES SHOWING POWER AND SPEED OF OUR STANDARD TRUMP TURBINES.

SIZE OF WHEELS	No. Feet Head	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
14 inch	Horse Power	41.3	44.	46.9	49.6	52.5	55.5	58.5	61.6	64.7	68.	71.	74.3	77.	80.9	84.	87.8	91.2	94.7
	Cubic ft. Water used per Minute	1185	1211	1236	1260	1285	1308	1331	1354	1376	1398	1421	1442	1463	1484	1504	1524	1544	1564
	Revolutions per Minute	462	472	481	491	502	509	518	527	536	545	553	561	570	578	586	594	601	609
17 inch	Horse Power	62.8	67.1	71.3	75.5	80.1	84.6	89.1	93.7	98.4	103.2	108.2	113.1	117.5	123.3	128.5	133.8	139.1	144.3
	Cubic ft. Water used per Minute	1808	1846	1884	1921	1958	1995	2029	2064	2097	2133	2166	2199	2231	2261	2293	2324	2355	2384
	Revolutions per Minute	380	388	396	404	413	419	427	434	441	448	455	462	469	476	482	489	496	501
20 inch	Horse Power	100.4	107.1	113.9	120.8	127.8	135.	142.3	149.7	157.2	164.3	172.8	180.7	187.4	196.8	205.2	213.5	221.8	230.5
	Cubic ft. Water used per Minute	2884	2946	3008	3067	3125	3182	3238	3294	3348	3402	3456	3508	3558	3609	3660	3708	3754	3803
	Revolutions per Minute	323	330	337	343	351	356	363	369	375	381	387	392	398	404	410	415	421	426
23 inch	Horse Power	133.4	142.2	151.2	160.4	169.7	179.2	189.	198.8	208.8	219.	229.4	240.	248.9	261.4	271.9	283.5	294.	306.
	Cubic ft. Water used per Minute	3828	3912	3996	4072	4149	4225	4299	4373	4445	4517	4588	4658	4725	4792	4858	4924	4987	5050
	Revolutions per Minute	281	287	293	299	305	310	315	321	326	331	336	341	346	351	356	361	366	371
26 inch	Horse Power	172.5	183.9	195.5	207.4	219.4	231.7	244.3	257.1	269.9	283.2	296.6	310.2	321.8	337.9	352.3	366.6	381.1	395.7
	Cubic ft. Water used per Minute	4950	5058	5163	5266	5364	5463	5558	5654	5747	5840	5932	6022	6109	6195	6282	6365	6449	6529
	Revolutions per Minute	244	250	255	259	265	269	274	278	283	288	292	296	301	305	309	314	318	322
30 inch	Horse Power	226.9	241.6	256.9	272.4	288.	304.5	321.	337.7	354.2	372.	389.7	407.	421.9	444.	462.9	481.4	500.7	519.4
	Cubic ft. Water used per Minute	6504	6646	6784	6918	7048	7178	7303	7429	7545	7673	7795	7912	8026	8140	8253	8363	8473	8578
	Revolutions per Minute	213	218	222	227	232	235	240	244	248	252	256	259	263	267	271	275	278	281
35 inch	Horse Power	309.4	329.7	350.6	371.9	393.5	415.4	438.	460.8	484.	507.7	531.8	556.2	577.	605.9	631.6	657.9	683.3	709.4
	Cubic ft. Water used per Minute	8875	9069	9257	9440	9617	9794	9966	10138	10304	10470	10636	10797	10952	11107	11262	11412	11562	11706
	Revolutions per Minute	183	188	191	196	200	203	207	211	214	217	220	224	227	231	234	236	240	243
40 inch	Horse Power	401.8	428.5	455.7	483.4	511.4	540.	569.3	599.	629.	659.9	691.2	723.9	749.9	787.5	820.9	854.3	888.	922.
	Cubic ft. Water used per Minute	11534	11786	12031	12269	12499	12729	12953	13176	13392	13608	13824	14032	14234	14436	14637	14832	15026	15213
	Revolutions per Minute	161	164	168	172	175	178	181	184	187	190	193	196	199	202	205	208	211	214
44 inch	Horse Power	486.1	518.4	551.3	584.7	618.6	653.3	688.7	724.5	760.9	798.3	836.1	874.5	907.2	952.7	993.1	1033.5	1074.3	1115.4
	Cubic ft. Water used per Minute	13953	14258	14554	14842	15120	15399	15669	15939	16200	16462	16723	16975	17219	17463	17707	17942	18177	18404
	Revolutions per Minute	147	150	153	156	159	162	165	167	170	173	176	178	181	183	186	189	191	193
48 inch	Horse Power	578.2	616.6	655.9	695.5	735.8	777.	819.2	861.7	905.	949.5	994.7	1040.2	1079.1	1133.	1186.4	1229.8	1277.8	1326.
	Cubic ft. Water used per Minute	16598	16959	17311	17653	17985	18316	18637	18958	19269	19580	19891	20191	20481	20771	21151	21341	21621	21902
	Revolutions per Minute	134	137	140	143	146	148	151	153	156	158	161	163	166	168	170	173	175	177
52 inch	Horse Power	675.2	723.8	769.7	816.	863.6	912.	961.6	1011.7	1062.3	1114.5	1167.3	1221.2	1270.	1330.	1386.	1442.	1499.	1557.
	Cubic ft. Water used per Minute	19480	19905	20319	20710	21109	21498	21875	22252	22617	22982	23347	23698	24000	24380	24721	25049	23377	25694
	Revolutions per Minute	121	127	129	132	135	137	139	142	144	146	148	151	153	156	158	160	162	164
56 inch	Horse Power	787.5	839.9	892.	947.3	1002.	1062.6	1111.3	1173.5	1232.	1293.	1354.	1416.	1469.	1543.	1608.	1674.	1740.	1806.
	Cubic ft. Water used per Minute	22604	23008	23577	24013	24491	24946	25383	25821	26244	26667	27081	27500	27895	28290	28685	29068	29447	29814
	Revolutions per Minute	115	118	120	123	125	127	129	132	134	136	138	140	143	145	147	149	150	152
61 inch	Horse Power	931.	992.	1055.5	1122.	1188.	1254.	1322.	1390.	1460.	1532.	1605.	1678.	1702.	1827.	1906.	1984.	2062.	2140.
	Cubic ft. Water used per Minute	26721	27205	27872	28490	29025	29560	30079	30597	31060	31600	32102	32587	33055	33523	33991	34443	34894	35329
	Revolutions per Minute	106	108	110	113	115	117	119	121	123	125	127	129	131	133	135	136	138	140
66 inch	Horse Power	1144	1221	1298	1376	1456	1538	1622	1705	1792	1880	1968	2060	2138	2243	2338	2434	2530	2627
	Cubic ft. Water used per Minute	32908	33585	34283	34960	35617	36273	36909	37545	38161	38776	39382	39987	40561	41136	41710	42264	42818	43352
	Revolutions per Minute	98	100	102	104	107	108	110	112	114	116	117	119	121	123	124	126	128	129

We Table Our Wheels at 80 Per Cent Efficiency, and They Give It.

TABLES OF OUR SMALL CAPACITY TURBINES FOR HIGH HEADS. WE ALSO BUILD SPECIAL TURBINES TO GIVE SPEED AND POWER YOU REQUIRE UNDER ANY HEAD FROM 30 TO 300 FEET.

SIZE OF WHEELS	No. Feet Head ☞	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
10 inch	Horse Power	15.8	16.4	17.	17.6	18.3	18.8	19.5	20.1	20.7	21.3	22.	22.7	23.4	24.	24.7
	Cubic ft. Water used per Minute	256	260	263	266	269	272	275	278	280	283	286	289	292	294	297
	Revolutions per Minute	882	893	903	914	924	934	945	956	965	974	983	994	1004	1012	1021
13 inch	Horse Power	25.5	27.5	28.4	29.5	30.4	31.5	32.5	33.6	34.7	35.6	36.8	37.9	38.9	40.1	41.2
	Cubic ft. Water used per Minute	428	433	438	443	448	453	458	463	468	472	477	482	486	491	495
	Revolutions per Minute	665	674	682	690	698	706	714	720	727	735	742	750	757	764	771
15 inch	Horse Power	34.4	35.7	37.	38.2	39.6	41.	42.3	43.7	45.1	46.4	47.8	49.2	50.7	52.1	53.6
	Cubic ft. Water used per Minute	556	563	569	576	582	589	595	602	608	614	620	626	632	638	644
	Revolutions per Minute	579	586	593	600	606	613	620	626	633	640	646	652	658	664	670
17 inch	Horse Power	46.4	48.1	49.8	51.6	53.4	55.2	57.	58.8	60.7	62.5	64.4	66.4	68.3	70.2	72.2
	Cubic ft. Water used per Minute	748	758	766	775	784	793	801	810	818	826	835	843	851	859	867
	Revolutions per Minute	504	510	516	523	529	535	541	546	552	558	564	568	573	578	583
20 inch	Horse Power	59.4	61.9	64.1	66.4	68.7	70.9	73.2	75.6	78.	80.4	82.8	85.3	87.8	90.3	92.8
	Cubic ft. Water used per Minute	962	974	985	997	1008	1019	1030	1041	1052	1062	1073	1084	1094	1104	1114
	Revolutions per Minute	441	446	451	457	462	467	472	478	482	487	491	497	501	506	510
23 inch	Horse Power	79.5	82.5	85.2	88.5	91.2	94.5	97.5	100.8	104.1	106.8	110.4	113.7	116.7	120.3	123.6
	Cubic ft. Water used per Minute	1284	1299	1314	1329	1344	1359	1374	1389	1404	1416	1431	1446	1458	1473	1485
	Revolutions per Minute	383	388	393	398	402	407	411	416	420	425	430	434	438	443	447

SIZE OF WHEELS	No. Feet Head ☞	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
10 inch	Horse Power	25.4	26.	26.7	27.4	28.1	28.8	29.5	30.3	31.1	31.7	32.4	33.1	34.2	34.8	35.5
	Cubic ft. Water used per Minute	300	302	305	308	310	313	315	318	321	323	325	327	330	333	335
	Revolutions per Minute	1032	1041	1050	1059	1068	1077	1086	1095	1102	1110	1118	1127	1136	1144	1152
13 inch	Horse Power	42.4	43.5	44.7	45.8	46.9	48.2	49.5	50.6	51.7	52.9	54.2	55.2	56.7	58.	59.2
	Cubic ft. Water used per Minute	500	504	509	513	517	522	526	531	534	538	543	547	551	555	559
	Revolutions per Minute	778	785	792	799	806	813	819	826	832	838	845	851	858	864	870
15 inch	Horse Power	55.1	56.5	57.	59.6	61.1	62.6	64.	65.8	67.3	68.8	70.4	72.	73.7	75.3	76.9
	Cubic ft. Water used per Minute	650	655	661	667	673	678	683	690	695	700	705	710	716	721	726
	Revolutions per Minute	676	682	688	694	700	706	712	718	724	730	735	740	746	751	757
17 inch	Horse Power	74.2	76.1	78.1	80.2	82.2	84.3	86.4	88.5	90.	92.7	94.8	97.	99.2	101.4	103.6
	Cubic ft. Water used per Minute	875	882	890	898	905	913	920	928	935	942	949	956	964	971	978
	Revolutions per Minute	589	597	602	606	610	615	620	625	630	635	640	645	650	655	659
20 inch	Horse Power	95.3	97.9	100.4	103.1	105.6	108.4	111.1	113.9	116.4	119.2	122.	124.8	127.6	130.4	133.2
	Cubic ft. Water used per Minute	1124	1134	1144	1154	1163	1174	1183	1194	1202	1211	1221	1230	1239	1248	1257
	Revolutions per Minute	516	520	525	529	534	538	543	548	551	555	559	563	568	572	576
23 inch	Horse Power	127.2	130.5	134.1	137.4	140.7	144.6	148.5	151.8	155.1	158.7	162.3	165.6	170.1	174.	177.6
	Cubic ft. Water used per Minute	1500	1512	1527	1539	1551	1566	1578	1593	1602	1614	1629	1641	1653	1665	1677
	Revolutions per Minute	452	456	461	465	470	474	478	482	486	489	493	496	500	503	507

TABLES OF OUR SMALL CAPACITY TURBINES FOR HIGH HEADS. WE ALSO BUILD SPECIAL TURBINES TO GIVE SPEED AND POWER YOU REQUIRE UNDER ANY HEAD FROM 30 TO 300 FEET.

SIZE OF WHEELS	No. Feet Head ☞	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
10 inch	Horse Power	36.3	37.	37.7	38.6	39.3	40.1	41.	41.7	42.5	43.3	44.2	44.8	45.8	46.6	47.5
	Cubic ft. Water used per Minute	338	340	342	345	347	349	352	354	356	358	361	363	365	367	369
	Revolutions per Minute	1160	1170	1178	1186	1194	1202	1210	1218	1226	1234	1242	1250	1257	1264	1272
13 inch	Horse Power	60.5	61.8	63.1	64.6	65.7	66.9	68.3	69.6	71.	72.3	73.6	75.1	76.4	77.8	79.2
	Cubic ft. Water used per Minute	563	567	571	575	579	582	586	590	594	597	601	605	608	612	616
	Revolutions per Minute	876	882	888	895	902	908	914	920	926	930	936	941	948	954	960
15 inch	Horse Power	78.7	80.4	82.1	83.9	85.6	87.3	89.	90.8	92.5	94.3	96.	97.8	99.6	101.4	103.2
	Cubic ft. Water used per Minute	732	737	742	747	752	757	762	767	772	777	781	786	791	796	800
	Revolutions per Minute	762	768	773	778	783	788	793	798	803	808	813	818	823	827	833
17 inch	Horse Power	105.9	108.1	110.3	112.6	114.9	117.2	119.5	121.9	124.3	126.6	129.	131.4	134.1	136.2	138.8
	Cubic ft. Water used per Minute	985	992	998	1005	1012	1019	1025	1032	1039	1045	1052	1058	1065	1071	1078
	Revolutions per Minute	664	668	672	677	681	687	691	696	700	704	708	712	716	721	726
20 inch	Horse Power	136.1	139.	142.	144.9	147.9	150.8	153.7	156.8	159.8	162.8	166.	168.8	172.1	176.4	178.3
	Cubic ft. Water used per Minute	1266	1275	1284	1293	1302	1310	1318	1327	1336	1344	1353	1361	1369	1377	1385
	Revolutions per Minute	580	585	589	593	597	601	605	609	613	617	622	625	628	632	636
23 inch	Horse Power	181.5	185.4	189.3	193.5	197.1	200.7	204.9	208.8	213.	216.9	220.8	225.3	229.2	233.4	237.6
	Cubic ft. Water used per Minute	1689	1701	1713	1725	1737	1746	1758	1770	1782	1791	1803	1815	1824	1836	1848
	Revolutions per Minute	510	514	517	520	523	526	528	531	534	538	541	544	547	550	553

SIZE OF WHEELS	No. Feet Head ☞	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
10 inch	Horse Power	48.3	49.2	50.	50.9	51.7	52.6	53.5	54.3	55.3	56.	57.1	58.	58.8	59.8	60.7
	Cubic ft. Water used per Minute	371	374	376	378	380	382	384	386	389	390	393	395	397	399	401
	Revolutions per Minute	1280	1287	1294	1301	1308	1315	1322	1329	1336	1343	1350	1357	1364	1371	1378
13 inch	Horse Power	80.	81.6	83.2	84.8	86.4	87.2	88.8	90.4	92.	93.6	95.2	96.	97.6	99.2	100.8
	Cubic ft. Water used per Minute	619	623	627	630	634	637	641	644	648	651	654	658	661	665	668
	Revolutions per Minute	965	970	976	981	987	992	998	1004	1009	1015	1020	1025	1030	1035	1040
15 inch	Horse Power	105.	106.4	108.7	110.6	112.5	114.3	116.3	118.1	120.	122.	124.	125.8	127.5	129.6	131.4
	Cubic ft. Water used per Minute	805	810	814	819	824	828	833	837	842	846	851	855	859	864	868
	Revolutions per Minute	836	841	848	855	862	869	873	876	880	886	889	893	897	900	904
17 inch	Horse Power	141.2	143.6	146.	148.5	151.2	153.6	156.2	158.8	161.3	163.9	166.4	169.1	171.7	174.4	177.1
	Cubic ft. Water used per Minute	1084	1090	1096	1102	1109	1115	1121	1127	1133	1139	1145	1151	1157	1163	1169
	Revolutions per Minute	731	735	739	743	747	752	757	760	764	768	772	776	780	784	788
20 inch	Horse Power	181.6	184.6	188.	191.	194.4	197.6	200.9	204.1	207.2	210.8	214.	217.4	220.8	224.2	227.6
	Cubic ft. Water used per Minute	1394	1401	1410	1417	1426	1434	1442	1449	1457	1465	1472	1480	1488	1495	1503
	Revolutions per Minute	640	643	646	650	654	657	661	664	668	671	675	678	682	685	689
23 inch	Horse Power	240.	244.8	249.6	254.4	259.2	261.6	266.4	271.2	276.	280.8	286.6	288.	292.8	297.6	302.4
	Cubic ft. Water used per Minute	1857	1869	1881	1890	1902	1911	1923	1932	1944	1953	1962	1974	1983	1995	2004
	Revolutions per Minute	556	559	562	565	568	571	574	577	580	583	586	589	592	595	598

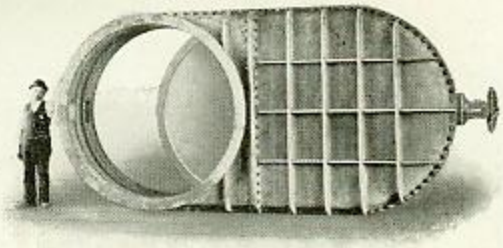
WE claim for our Horizontal Turbine a better efficiency than can be given by any other Turbine. You may ask why, and we refer you to the cut of our Runner on page 7, in which you will observe that we have a broad discharge and a very shallow wheel, measuring below the gate-line.

Having but little center discharge, the water in leaving the wheel is out of the way and is not wallowed around the shaft as is the case in many other large capacity Turbines. It is a well-known fact that center discharge Turbines give very poor results when placed horizontally. Again, we claim the shape of our Runner gives direction to the water as it discharges. The discharge covers a large area, and as we use elbows of ample size there is no clogging, the water leaving the Turbine at a comparatively low velocity.

Noi dichiariamo e sosteniamo che le nostre turbine orizzontali dànno a pieno carico un rendimento più alto di qualunque altra turbina. La speciale costruzione della girante o ruota mobile avente un ampio scarico, permette all'acqua di uscire dalla turbina, senz'essere portata attorno all'asse come succede nelle turbine a scarico centrale; infatti l'acqua abbandona la turbina con una velocità minore che in qualunque altra di simile capacità. Il rendimento di una turbina orizzontale di grande portata è del 5% inferiore a quello di una turbina verticale della medesima potenza.

Vi påstå att våra turbiner gifva högre verkningsgrad än andra turbiner. Detta på grund af krafthjulets konstruktion, som är lågt ock har rymligt aflopp.

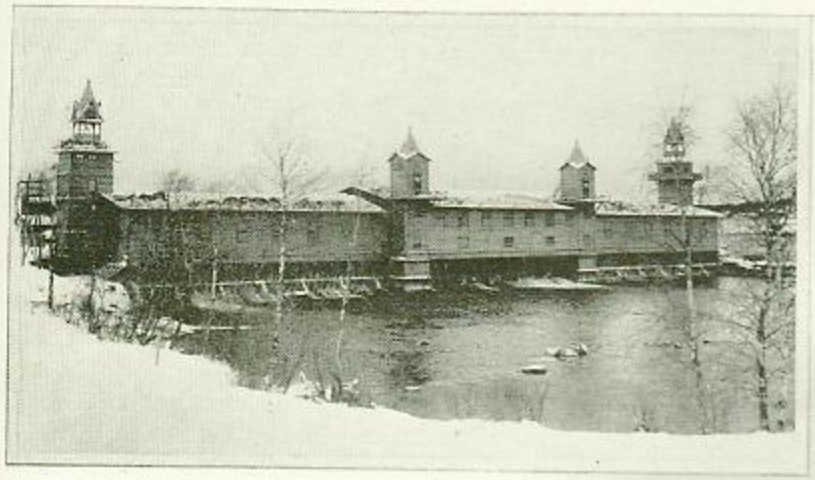
I våra turbiner finnes föga aflopp inåt axeln. Vattnet lemnar turbinen på ett fritt sätt, och föres ej rundt ikring axeln, som fallet är vid många andra större turbiner. Det är ett kändt faktum, att turbiner med dylikt aflopp gifva mycket dåliga resultat, när de uppställas horisontalt. Skoflarna i våra turbiner gifva åt vattnet den rätta rigtningen.



WE manufacture large size gate valves for use in connection with our high head turbines. The cut shown was taken from photo of a 7 ft. valve. All of our large valves have a by-pass of ample size, hence but little power is required to open and close the main valve. We use bronze screw and nut on all sizes and we use bronze face on both seat and gate. We also manufacture gate gearing for wooden head-gates and wicket gates to be used in connection with same. A wicket gate in a wooden head gate accomplishes the same purpose as a by-pass valve on a large iron gate valve.

Fabbrichiamo pure molti articoli speciali usati negl'impianti di turbine, per es.; valvole a farfalla, saracinesche, distributori, paratoje e meccanismi o congegni per la loro manovra, e in generale qualunque accessorio per questo genere di impianti, eccetto i Regolatori. Consideriamo la costruzione di questi apparecchi come un ramo separato e preferiamo che i nostri Clienti li acquistino direttamente dai costruttori specialisti. Noi forniremo loro tutti quei dati che essi ci chiederanno relativi alle nostre turbine.

Vi tillverka stora pådragsventiler att användas vid våra turbiner för höga fall. Bilden visar en sjufots ventil. Alla våra stora ventiler hafva en sidventil af tillräcklig storlek, så att blott föga kraft behöfves för att öppna och stänga hufvudventilen. Vi använda för alla storlekar skrufvar och muttrar af brons och anliggsytorna äro af brons både på ventilen och i sätet. Vi tillverka likaledes kugganordningar, etc., för pådrag af trä.



Sittolo Aktiebolag, Finland

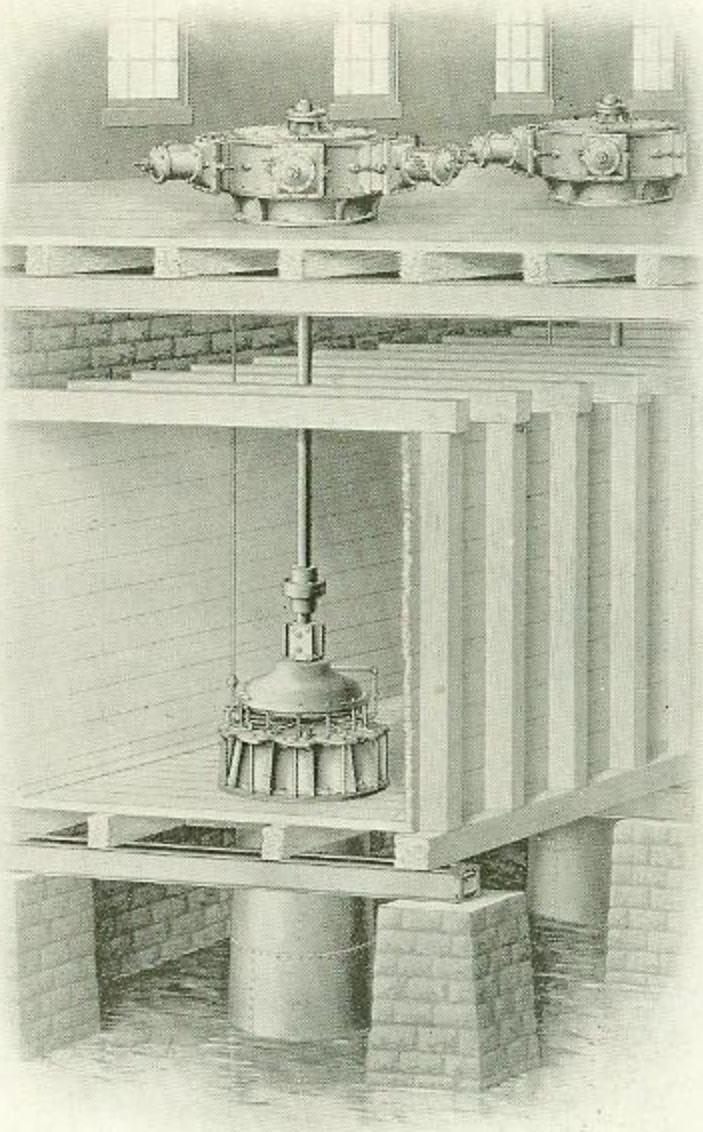
ON opposite page we show Pulp Grinder driven by Vertical turbine with stone attached direct to top of turbine shaft. Driving the Pulp Stones in this way may seem rather out of place in this country, while in Norway and Sweden a great many Pulp Mills are driven in this manner. We have sold quite a number of wheels for this purpose, carrying the weight of the stone, together with the thrust of the turbine, on our Improved Water Cushion, and they have given the best of satisfaction.

Our Water Cushion is the only device on the market by which the weight can be carried automatically. No matter what the gate-opening on the turbine may be, the Cushion adjusts itself instantly to the conditions. Formerly, where Grinders were driven in this manner, the weight was carried on Friction Rollers, which were troublesome and required constant attention.

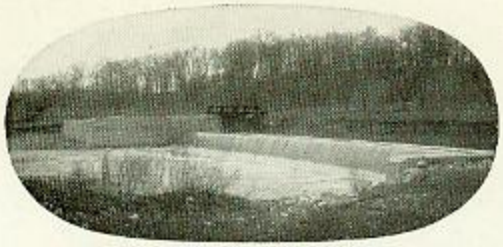
Sulla pagina qui contro diamo l'illustrazione di una sfibratrice per macinare polpa di legno per la fabbricazione della carta. Il legno viene sfibrato comprimendolo contro una macina in pietra, girante alla velocità di 200 giri per minuto, e continuamente lavato da una corrente d'acqua che ne asporta la parte sfibrata. I nostri lettori italiani non avranno forse molta esperienza di questo genere di lavoro. Per contro, nella Svezia e Norvegia sono largamente in uso le sfibratrici comandate in questo modo.

Noi facciamo sopportare il peso della macina (circa 2500 Kg.) insieme col peso dell'acqua dal nostro perfezionato congegno d'equilibrio senza usura o frizione.

På motsatta sidan visa vi en defibrör, som drifves direkt af en vertikal turbin. Detta sätt att fästa stenen på turbinaxeln användes rätt mycket i Sverige och Norge. I dylika fall upptaga vi både trycket af turbinen och vigten af stenen genom vår patenterade vattenfjädring, hvilken anordning synes gifva fullkomlig tillfredsställelse. Denna anordning är den enda i marknaden förekommande, som kan bära vigten automatiskt. Huru mycket pådraget än öppnas, inställer sig skifvan, som den bör. När defibrörer voro drifna på detta sätt förr i tiden, uppbars vigten af friktionsrullar, hvilka voro besvärliga och fordrade ständig tillsyn.



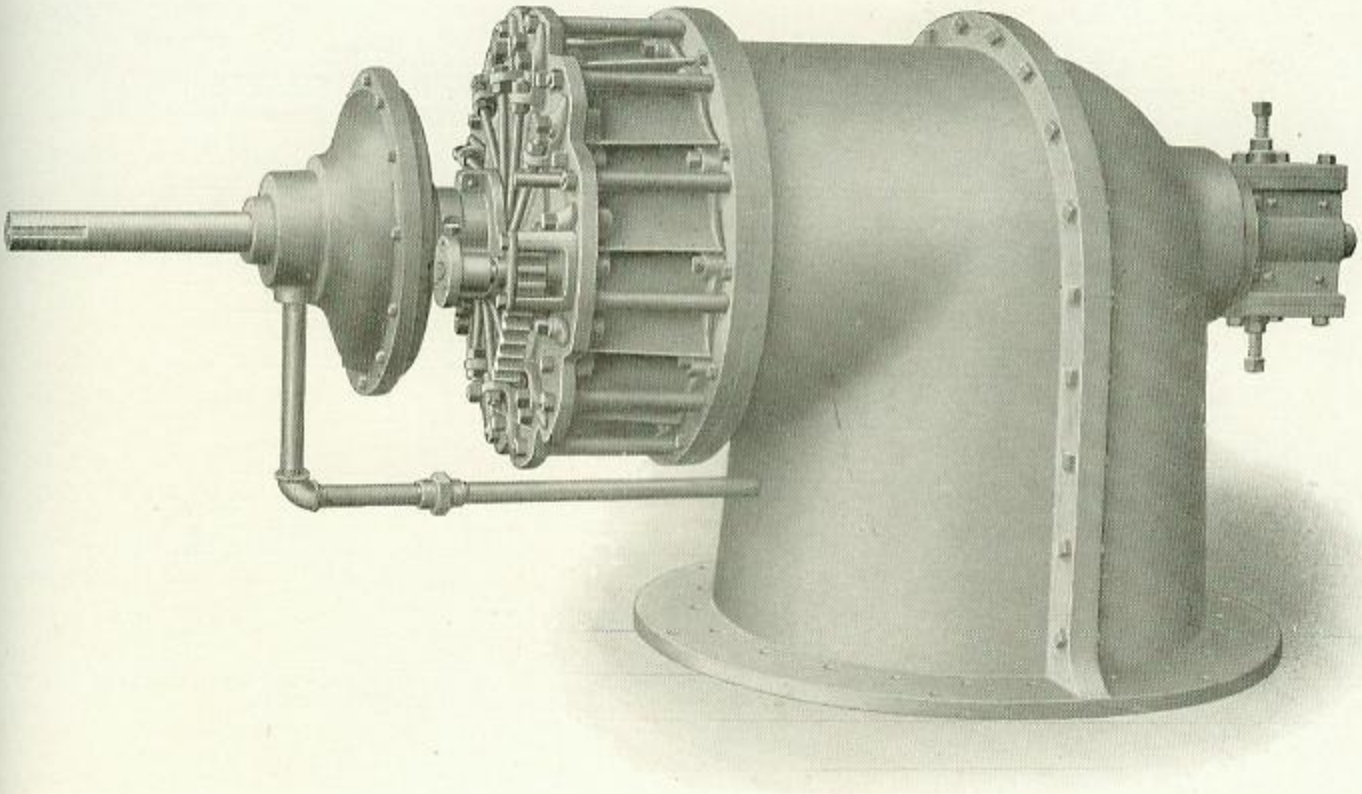
Driving Pulp Stone on Top Turbine Shaft



FOR a small power with medium head there is no better Horizontal arrangement than that shown on opposite page. Our Single Wheels on draft-chest have no equal. Where wheels of this style are supplied with Water-Cushion, which takes careof all end-thrust perfectly without wear or friction, there is no power lost from friction, as is the case where wooden thrust bearings are used. The Cushion is automatic under all conditions, full or part gate, and when you consider the amount of power lost by friction where bevel gearing is used to transmit the power from a Vertical turbine, it will be seen that a Single Horizontal wheel for a medium head is much more desirable than a Vertical; in fact, the first cost will not exceed that of a Vertical wheel, gears and shafting.

Per piccole forze sotto medie cadute non vi è disposizione orizzontale migliore di quella illustrata sulla pagina dirimpetto. Le nostre turbine semplici, con tubo d'aspirazione a gomito, sono provviste del nostro perfezionato congegno equilibratore, cosicchè non vi è movimento di spinta sull'asse, nè vi è a temere usura o frizione. Una turbina disposta in questo modo, dà un rendimento tanto alto, come se installata in camera di acciaio, e, dove si equilibra la spinta, come noi facciamo col nostro perfezionato cuscinetto, non vi è perdita di forza. Il congegno è automatico sotto qualunque condizione, sia a piena che a parziale apertura di registro.

För lågt fall och liten kraft finnes ingen bättre horisontal anordning än den, som visas på motsatta sidan. Våra enkla turbiner med vattenfjädring, som upptager allt sidtryck utan nötning eller friktion, förlora ingen kraft genom friktion, som fallet är när stödlager med träskifvor användas. Bärskifvan verkar fullt automatiskt vid fullt eller delvist pådrag. När man tager i betraktande all den kraft, som förloras genom friktion, när kugghjul användas att förmedla kraften från en vertikal turbin, ser man tydligen att en enkel horisontal turbin är mycket fördelaktigare. Ett faktum är, att den första kostnaden är ej så stor som för en vertikal turbin med kugghjul och axlar.



Single Turbine on Draft Chest with Water Cushion

STEEL SHAFTING

HORSE POWER OF LINE SHAFTS

Bearings Every Eight Feet

$$\text{H. P.} = \frac{D^3R}{75}$$

DIAM. OF SHAFT INCHES	REVOLUTIONS PER MINUTE				
	1	50	100	150	200
3	.36	18.	36	54	72
3¼	.4577	22.88	45.77	68.64	91.54
3½	.5716	28.58	57.16	85.74	114.32
3¾	.7031	35.15	70.31	105.45	140.62
4	.8533	42.66	85.33	127.98	170.66
4¼	1.023	51.17	102.3	153.51	204.70
4½	1.215	60.75	121.5	182.25	243
5	1.666	83.33	166.6	249.99	333.32
5½	2.218	110.9	221.8	332.7	443.7
6	2.88	144	288	432	576
6½	3.661	183.1	366 2	549.2	732.3
7	4.573	228.7	457.3	686	914.7
7½	5.625	281.3	562.5	843.8	1125
8	6.826	341.3	682.7	1024	1365

To find the H. P. at speeds not given in the table, multiply the H. P. at 1 r. p. m. by the desired speed.

STEEL SHAFTING

HORSE POWER OF SHAFTS

For Simply Transmitting Power

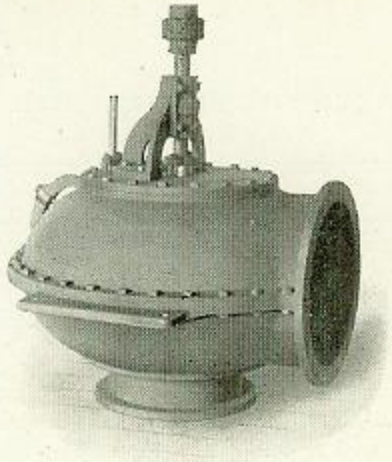
$$\text{H. P.} = \frac{D^3R}{50}$$

DIAM. OF SHAFT INCHES	REVOLUTIONS PER MINUTE				
	1	50	100	150	200
3	.54	27.	54	81	108
3¼	.6865	34.32	68.65	102.9	137.3
3½	.8575	42.87	85.75	128.6	171.5
3¾	1.054	52.73	105.4	158.1	210.9
4	1.28	64	128	192	256
4¼	1.535	76.76	153.5	230.2	307
4½	1.822	91.12	182.2	273.3	364.5
5	2.5	125	250	375	500
5½	3.327	166.4	332.8	499.1	665.5
6	4.32	216	432	648	864
6½	5.492	274.6	549.3	823.9	1099
7	6.86	343	686	1029	1372
7½	8.437	421.9	843.8	1266	1688
8	10.24	512	1024	1536	2048

Shafts for simply transmitting power may have bearings further apart, say 10' 0" to 12' 0", instead of every 8' 0".

METRIC TABLE OF STANDARD TRUMP TURBINES SHOWING HEAD AND QUANTITY OF WATER USED.

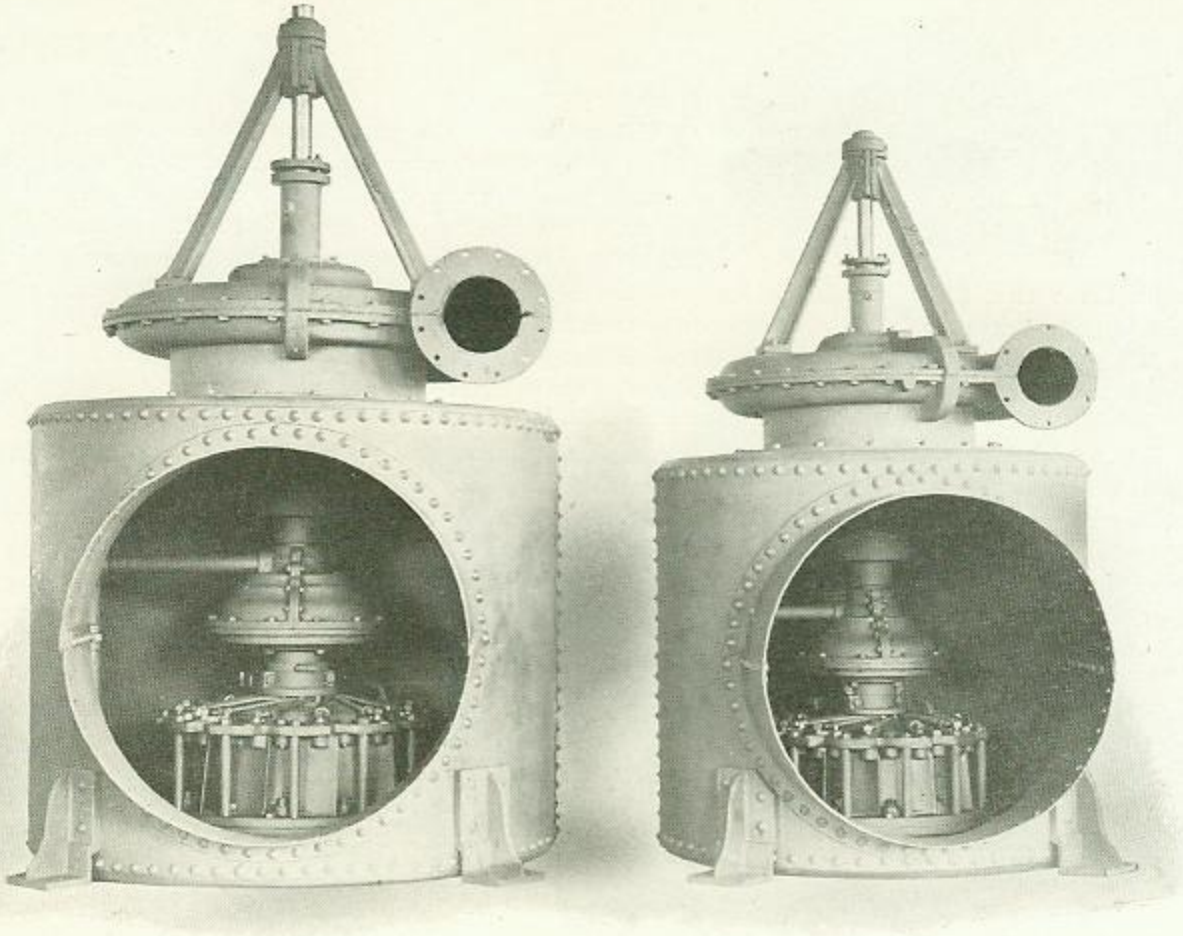
SIZE OF WHEELS	Metres Fall	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5
14 inch.	Hastkrafter	4.1	6.3	8.8	11.5	14.5	17.8	21.2	24.9	29.1	32.7	36.9	41.2	45.7	49.9	55.6	60.1	65.1	70.4	75.7
	Vattenmangd i Liter per Sekund	256	296	333	363	392	422	444	473	495	518	540	555	577	592	614	629	651	666	681
	Omloppstal per Minut	213	245	274	300	325	348	370	391	408	420	444	461	477	494	509	522	537	551	565
17 inch.	Cavallo Vapore	6.2	9.5	13.	17.5	22.	27.2	32.2	37.6	43.4	49.5	55.8	62.4	69.	76.2	84.1	91.2	98.4	104.	114.4
	Litri d'Acqua per Min. Secondo	392	448	504	549	594	638	672	717	750	784	818	840	874	890	924	952	986	1008	1030
	Rivoluzioni per Minuto	175	202	226	247	268	287	305	320	339	350	365	379	392	406	419	430	442	453	465
20 inch.	Horse Power	10.	15.3	21.4	28.1	35.4	43.3	51.4	60.5	70.	79.5	90.	100.2	111.1	123.	135.2	146.4	158.4	171.2	184.
	Liters Water Per Second	630	720	810	891	954	1026	1080	1152	1206	1260	1314	1350	1404	1440	1494	1530	1584	1620	1656
	Revolutions per Minute	140	172	192	210	227	244	258	272	286	298	311	322	334	345	356	366	376	384	394
23 inch.	Horse Power	13.2	20.2	28.3	37.2	46.9	57.2	68.3	80	92.5	105.1	118.6	132.6	147	162	179	193.2	209.5	226.4	243.4
	Liters Water per Second	833	952	1071	1178	1261	1356	1428	1523	1595	1666	1737	1785	1856	1904	1975	2023	2094	2142	2190
	Revolutions per Minute	120	150	168	183	198	212	225	236	248	259	270	280	290	300	309	317	326	335	343
26 inch.	Horse Power	17.1	26.4	37.	48.	61.	74.	89.	104.	122.	137.	154.	173.	191.	211.	233.	251.	273.	294.	314.
	Liters Water per Second	1085	1240	1395	1534	1643	1767	1860	1984	2077	2170	2263	2325	2418	2480	2573	2635	2728	2790	2852
	Revolutions per Minute	112	130	145	159	172	184	195	205	215	225	234	243	251	260	269	276	282	289	297
30 inch.	Horse Power	29.1	45.6	49.7	65.4	82.4	100.6	120.1	143.1	162.3	184.9	208.6	232.8	258.5	284.8	313.6	339.7	368	398	428
	Liters Water per Second	1405	1674	1884	2072	2219	2386	2512	2679	2805	2980	3056	3139	3265	3349	3474	4558	3684	3767	3851
	Revolutions per Minute	98	112	126	138	149	159	168	177	187	195	203	211	218	225	232	238	245	251	257
35 inch.	Horse Power	39.4	47.	65.4	86.	108.6	132.5	158.2	185.2	214.	245.5	274.5	307.	338.	375.	414.	447.2	485.	524.	563.
	Liters Water per Second	1928	2304	2480	2727	2920	3141	3306	3526	3692	3857	4022	4132	4298	4408	4573	4683	4849	4959	5069
	Revolutions per Minute	85	98	110	120	130	140	148	156	162	170	177	183	189	197	203	209	214	219	225
40 inch.	Horse Power	40	61.2	86	112.4	142	173.2	206	242	280	318	360	401	444.4	492	541	586	634	685	739
	Liters Water per Second	2520	2880	3240	3564	3816	4104	4320	4608	4824	5040	5256	5400	5616	5760	5976	6120	6336	6480	6624
	Revolutions per Minute	75	86	96	105	114	122	129	138	143	149	155	161	167	173	178	183	188	192	197
44 inch.	Horse Power	48.2	74.4	103.4	134.1	171.4	209.4	250.1	293	338	385	434.1	488.4	539	593	654.4	707	767	829	889
	Liters Water per Second	3048	3484	3919	4311	4616	4965	5226	5574	5839	6097	6358	6532	6794	6968	7229	7403	7665	7839	8013
	Revolutions per Minute	68	78	87	95	103	111	117	125	130	136	141	147	152	157	162	166	170	174	179
48 inch.	Horse Power	57.3	88.1	123.	162.	204.	249.	297.	348.2	402.	458.	516.3	577.	640.	705.1	778.4	841.	912.	986.	1059.2
	Liters Water per Second	3629	4144	4662	5128	5491	5905	6216	6630	6941	7252	7563	7770	8081	8288	8599	8806	9117	9324	9631
	Revolutions per Minute	62	71	80	88	95	102	108	113	119	124	129	134	138	143	148	152	156	160	164
52 inch.	Horse Power	67.2	103.4	144.4	190	239.2	292.4	349.1	409	472	537.8	605.1	677	751	828	914	987.1	1070.4	1158.4	1244
	Liters Water per Second	4256	4864	5472	6019	6445	6931	7296	7782	8147	8512	8877	9123	9488	9728	10093	10338	10701	10944	11187
	Revolutions per Minute	57	66	74	81	87	93	98	105	110	115	119	124	128	133	137	141	144	148	152
56 inch.	Horse Power	77	120	167.2	220	278	339	406.1	474.4	548.4	624	703	785.4	870.2	960.4	1061.5	1144	1240	1342	1442.3
	Liters Water per Second	4938	5644	6349	6984	7478	8043	8465	9030	9454	9877	10300	10582	11006	11288	11711	11993	12417	12699	12981
	Revolutions per Minute	53	61	68	75	81	87	92	97	102	107	111	115	119	124	127	130	134	137	141
61 inch.	Horse Power	92.4	142.4	198.8	261.6	329.6	402.4	480.4	562.4	649.2	739.6	834.4	931.2	1034	1139.2	1254.4	1358.8	1472	1592	1712
	Liters Water per Second	5899	6696	7596	8288	8876	9544	10048	10716	11230	11720	12224	12556	13060	13396	13896	14232	14736	15068	15404
	Revolutions per Minute	49	6	63	69	75	80	84	89	94	98	102	105	109	112	116	119	123	126	129
66 inch.	Horse Power	113.7	175.5	243.6	319	405	495	589	733	798	910	1024	1141	1267	1385	1544	1666	1806	1951	2093
	Liters Water per Second	7263	8232	9261	10082	10854	11830	12348	13738	13171	14406	15025	15425	16052	16464	17081	17493	18131	18522	18933
	Revolutions per Minute	46	52	58	63	69	73	78	83	87	91	95	98	101	105	108	111	114	117	120



WE build Vertical Penstocks, or Cases, for all sizes of wheels, and, where required, we attach harness to the top of casing to carry the gearing, jack-shaft, etc. Where vertical wheels are placed under high heads there is always more or less loss from leakage when wheels are placed in wooden penstocks. It is always better to use a steel penstock where the head exceeds 20 feet. Penstocks for the larger sizes of Turbines have cast iron heads and sheet steel sides. For the smaller sizes we use cast iron Globe Cases, with removable plate on top, so that the wheel can be placed in position after the penstock is set in place. Our larger Penstocks have large Manholes on the side to give access to the wheel and have removable Plate on top so the wheel can be taken out without disturbing the supply pipe.

Allorchè s'impiantano in camere libere turbine ad asse verticale sotto cadute maggiori di 15 piedi (circa 5 metri), è meglio collocarle in pozzi metallici o in muratura, poichè rimangono così evitate le perdite cagionate da fughe, che facilmente avvengono quando si fa uso di camere in legno. Sono pure raccomandabili le camere costrutte in pietrame. Dove per l'aspirazione si fa uso di tubazioni o condotte, la turbina può essere collocata a 15 o 20 piedi (6-7 metri) sopra il pelo d'acqua del canale di scarico. L'impiego dei tubi di conduttura di aspirazione, comunemente detti di scarico, non cagiona alcuna perdita, ma per essere efficaci i tubi devono essere a perfetta tenuta d'aria.

Vi bygga vertikala turbinhus för alla turbinstorlekar, och plasera,–om så fordras–en ställning ofvanpå, för att uppbära kugghjulen, hufvudaxeln, etc. On vertikala turbiner plaseras under högt fall, förefinnes alltid mer eller mindre förlust genom läckning. Särskildt är detta fallet då träsumpar användas. Är fallet öfver 15 fot (=4.5 m) bör man alltid använda turbinhus af stål. Turbinhusen för större turbiner hafva öfre delen af gjutjärn och sidorna af stålplåt. För de mindre storlekarne använda vi klotformade hus af gjutjärn, försedda med lock, så att turbinhuset kan uppsättas innan turbinen plaseras däri.



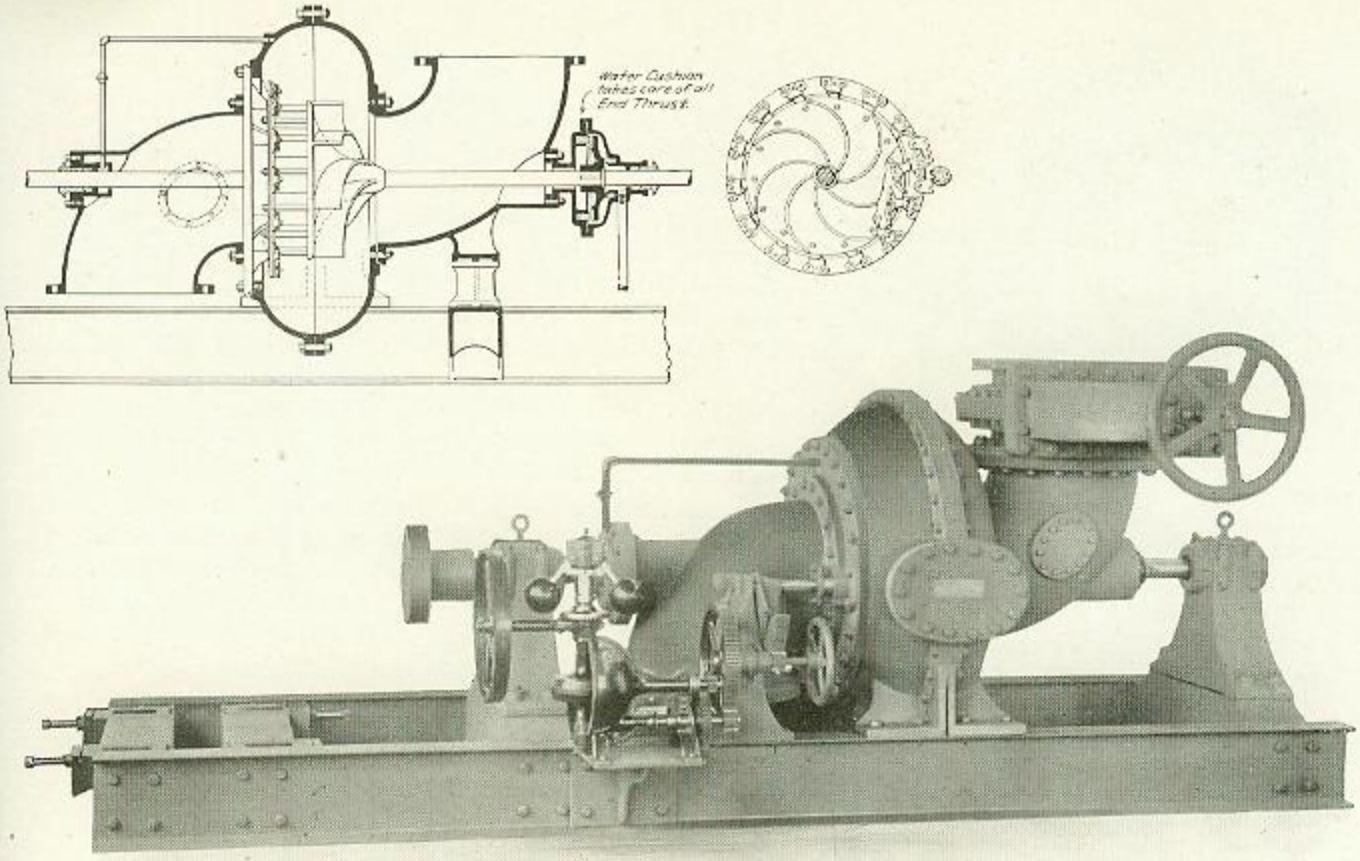
Vertical Turbines Direct Connected to Centrifugal Pumps

THE cut on opposite page shows the most efficient manner of driving a Generator (using a Horizontal turbine) coupling direct to turbine shaft. Sometimes it is necessary to use a pair of wheels, but where the power and speed required can be given by a Single wheel it is more satisfactory, especially where the endthrust can be taken care of by Water Cushion, as there is absolutely no end movement of the shaft where this device is used ; hence rigid face couplings can be used for connecting generator and turbine shaft.

Another advantage in favor of Single Wheels is that you have but half the number of parts in a Single wheel that you have in a pair, hence the liability to break-down is reduced one-half.

La maggior parte delle grandi stazioni centrali idroelettriche sono oggidì comandate come illustrato sulla pagina qui contro, cioè con generatore direttamente accoppiato sull'asse della turbina. Si evita così ogni perdita per trasmissione della forza dalla turbina al generatore e, dove viene adottato il nostro perfezionato congegno d'equilibrio, non vi è assolutamente movimento di spinta sull'asse del generatore. L'uso di una turbina semplice, a preferenza di una coppia di turbine, offre il vantaggio di avere soltanto la metà di parti (organi) da sorvegliare, quindi la possibilità di guasti è ridotta a metà. Impiegando due turbine calettate su di un asse unico, la spinta assiale diminuisce più o meno, ma non la si evita mai totalmente.

Bilden på motsatta sidan visar det lämpligaste sättet att drifva en generator, genom att använda en horisontal turbin och koppla direkt till turbinaxeln. Ofta är det nödvändigt att använda ett par hjul ; men kan kraften och hastigheten erhållas genom en enkel turbin, är detta mera tillfredsställande, synnerligast när sidtrycket kan upptagas genom vattentryck. Då förefinnes absolut ingen längdförskjutning af axeln. En annan fördel med enkla hjul är den, att endast hälften så många delar finnas som i ett par, hvarigenom risken för brytning är just hälften så stor.

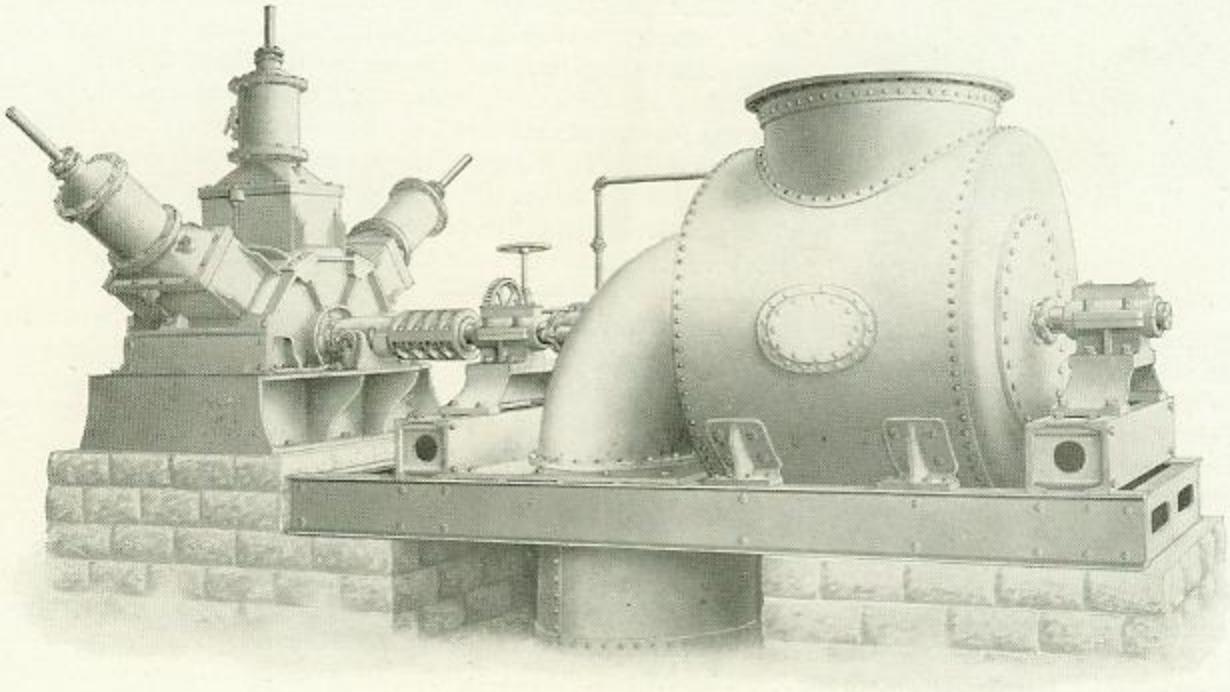


High Head Type for Direct Connection to Generator

ON opposite page we show turbine driving Pulp Grinder direct Where Grinders are driven in this manner using Single Wheels it is preferable to connect the Grinder to the discharge or elbow end of turbine casing, bringing the discharge pipe nearer the center of the wheel frame, thus making the wheel accessible from the opposite head. Several Grinders can be placed in a line if necessary. Our Tables may not show Wheels making the number of revolutions required. You should bear in mind, however, that we build Special wheels to suit the various conditions as to power and speed. Always state what power you wish and give number of revolutions required and head wheel is to be placed under.

Sulla pagina dirimpetto è illustrata la nostra turbina orizzontale semplice, azionante una sfibratrice o macchina a sfibrare legno, riducendolo in polpa, colla quale si fabbrica la carta. La maggior parte delle sfibratrici da legno, usate nelle cartiere degli Stati Uniti, sono del tipo orizzontale e comandate come mostra l'incisione. Ogni macina assorbe 200 o 300 HP e le turbine devono essere costrutte per una velocità di circa 200 giri al minuto 1°. Dove si può è preferibile di usare una turbina semplice piuttosto che due turbine accoppiate. Noi fabbrichiamo turbine speciali adatte per le varie condizioni di forza e velocità.

Å motsatta sida visa vi en turbin, som drifver en defibrör direkt. När defibrörer äro drifna på detta sätt af enkla hjul, är det fördelaktigt att koppla dem på turbinhusets afloppssida. Härigenom fås afloppsröret närmare midtpunkten af ramen, och man kan lätt komma åt krafthjulet från andra sidan. Flera defibrörer kunna plaseras i linie, om så är erforderligt. Våra tabeller visa måhända ej det erforderliga omloppstalet, men vi fästa uppmärksamheten på, att vi bygga särskilda turbiner, hvilka gifva den erforderliga kraften och hastigheten.



Turbine Direct Connected to Pulp Grinder

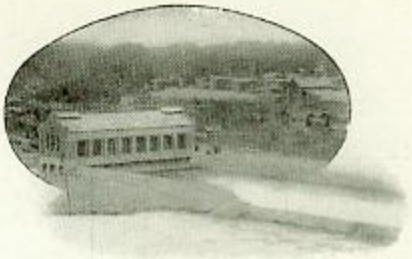
OUR large Turbines are the most powerful built and are especially adapted to low and medium heads. There is no wheel on the market that will give as much power as our 66-inch, and when you consider that this wheel under ten feet head actually gives 327 horse-power, you can see that our claim of building the most powerful Turbine in the world is realized. We make no claim that we cannot fulfill and our wheels show by actual test more power than they are tabled to give. The peculiar shape of our runner allows a large discharge of water at a low velocity hence does not clog in back water.

Le nostre turbine Modello sono le più robustamente costrutte e sono adatte per basse e medie cadute. Non vi è altra, turbina sul mercato che sviluppi tanta forza quanto la nostra Modello di 66'' e, se si considera che questa turbina dà 712 HP, sotto una caduta di 5 metri, si deve riconoscere dimostrata la nostra asserzione di essere noi i costruttori della più potente turbina del mondo. Non facciamo asserzioni, che non possiamo sostenere. Le nostre turbine attualmente dànno maggior forza che non sia indicato sulle tabelle, e ancora sosteniamo che le nostre ruote "HIGH GRADE" per alte cadute, sono impareggiabili, sia per robustezza, che per durata e rendimento.

Våra stora turbiner äro de kraftigast byggda, och äro särskildt ämnade för låga och medelhöga fall. Det finnes ingen turbin i marknaden af samma storlek som utvecklar så mycken kraft, som vår 66 tums turbin. När man betänker att detta hjul under 10 fots fall (=3 m) verkligen gifver 327 hästkrafter, kan man tydligen se att vårt påstående – att vi bygga den mest kraftfulla turbin i verlden – är ett faktum. Vi lofva ej, hvad vi ej kunna stå för. Genom verkliga prof har det bevisats, att våra turbiner gifva mera kraft än hvad vi i tabellerna uppgifva.

TABLE SHOWING DISCHARGE OF WATER UNDER VARIOUS HEADS.

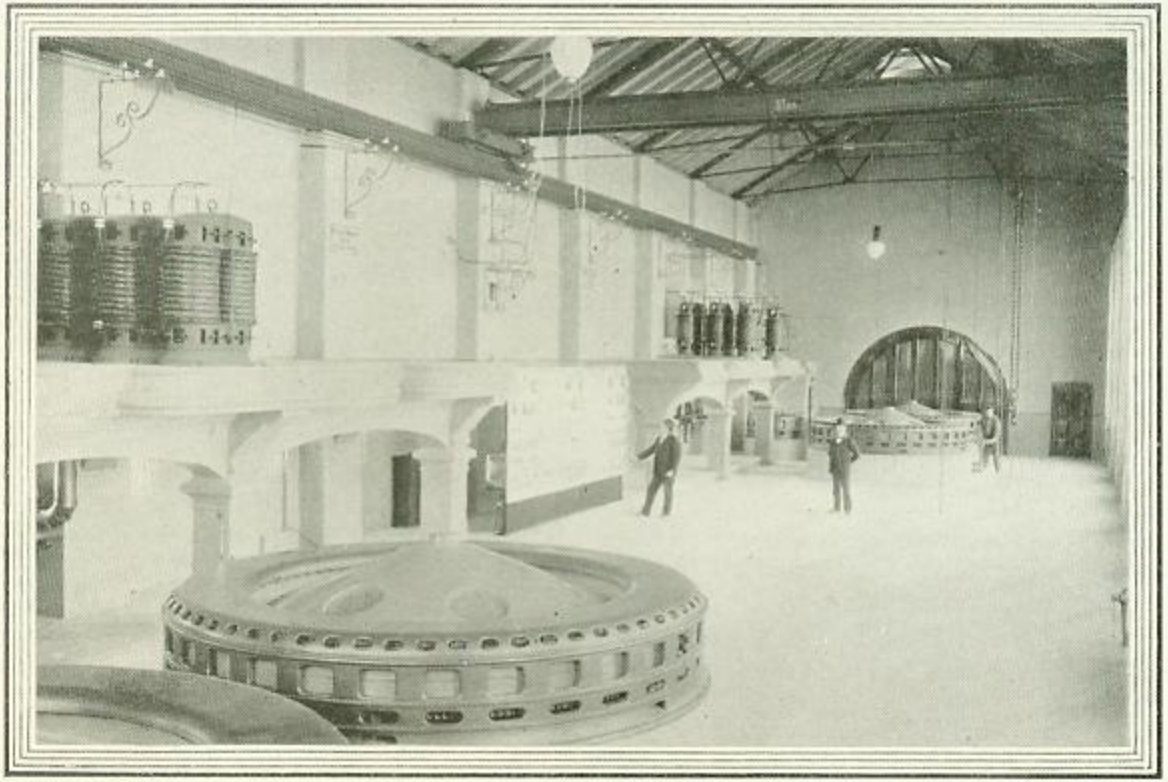
FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING	FEET HEAD	CUBIC FEET DIS. PER MIN. FOR EACH SQ. IN. OPENING
1	3.34	12	11.57	23	16.02	34	19.49	45	22.40	56	24.99	67	27.33	78	29.49	89	31.50
2	4.73	13	12.05	24	16.37	35	19.77	46	22.65	57	25.21	68	27.54	79	29.68	90	31.68
3	5.79	14	12.50	25	16.71	36	20.05	47	22.89	58	25.43	69	27.74	80	29.87	91	31.86
4	6.68	15	12.94	26	17.05	37	20.33	48	23.14	59	25.65	70	27.94	81	30.06	92	32.04
5	7.47	16	13.37	27	17.36	38	20.60	49	23.38	60	25.87	71	28.14	82	30.24	93	32.20
6	8.18	17	13.78	28	17.68	39	20.87	50	23.61	61	26.08	72	28.34	83	30.42	94	32.38
7	8.84	18	14.18	29	17.99	40	21.13	51	23.85	62	26.29	73	28.53	84	30.61	95	32.55
8	9.45	19	14.57	30	18.30	41	21.38	52	24.08	63	26.54	74	28.73	85	30.79	96	32.72
9	10.02	20	14.95	31	18.60	42	21.64	53	24.31	64	26.72	75	28.93	86	30.97	97	32.89
10	10.51	21	15.31	32	18.90	43	21.90	54	24.54	65	26.92	76	29.11	87	31.15	98	33.06
11	11.08	22	15.67	33	19.20	44	22.15	55	24.76	66	27.13	77	29.30	88	31.33	99	33.23
																100	33.40



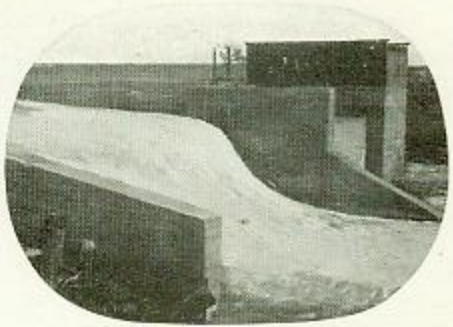
ON another page we speak of carrying heavy weights on top of Turbine shaft. The cut on opposite page is reproduced from photograph of an electric light station in Sweden, where the generators are connected direct to top of Turbine shaft. We are driving several plants of this kind in foreign countries where this style of generator is largely used. The generators in the cut referred to are driven by 56 inch Trump wheels. We have wheels as large as 61 inches driving generators in the same manner. Where wheels are placed under high heads a much higher speed can be obtained; hence the cost of generator will be much less. We claim this to be the most simple and economical way to drive a generator where the conditions are favorable as to speed and power. The first cost is less than where Horizontal Turbines are used and we will guarantee the results.

L'incisione qui di fronte, tratta da una fotografia d'un impianto in Isvezia, azionato da turbine Trump, rappresenta dei generatori calettati sull'estremità d'un albero di turbina ad asse verticale. Dove la caduta è di sufficiente altezza si può ottenere un'alta velocità, e, col nostro congegno equilibratore, il peso o pressione dell'acqua viene sopportata senza alcuna usura o attrito. Diamo più avanti illustrazione del disco equilibratore, e sosteniamo essere questo il solo mezzo pratico di sopportare considerevoli pressioni sull'albero della turbina; esso è assolutamente automatico, qualunque sia il grado d'apertura del distributore della turbina.

På annat ställe afhandla vi, huru tunga vigter kunna uppbäras af turbin-axeln. På motsatta sidan visa vi en elektrisk belysningsanläggning i Sverige, hvarest generatorerna äro direkt drifna. Vi drifva åtskilliga anläggningar af detta slag i utlandet, hvarest denna typ af generatorer användes mycket. Dynamomaskinerna i ofvan anförda bild äro drifna af 56 tums Trump-turbiner. Vi hafva äfven turbiner så stora som 61 tum i diameter, hvilka drifva generatorer på samma sätt. Är fallet högt, erhålles mycket större hastighet och kostnaden af generatorn blifver sålunda mycket mindre.



Norberg's Electriska, Karrgrufvan, Sweden



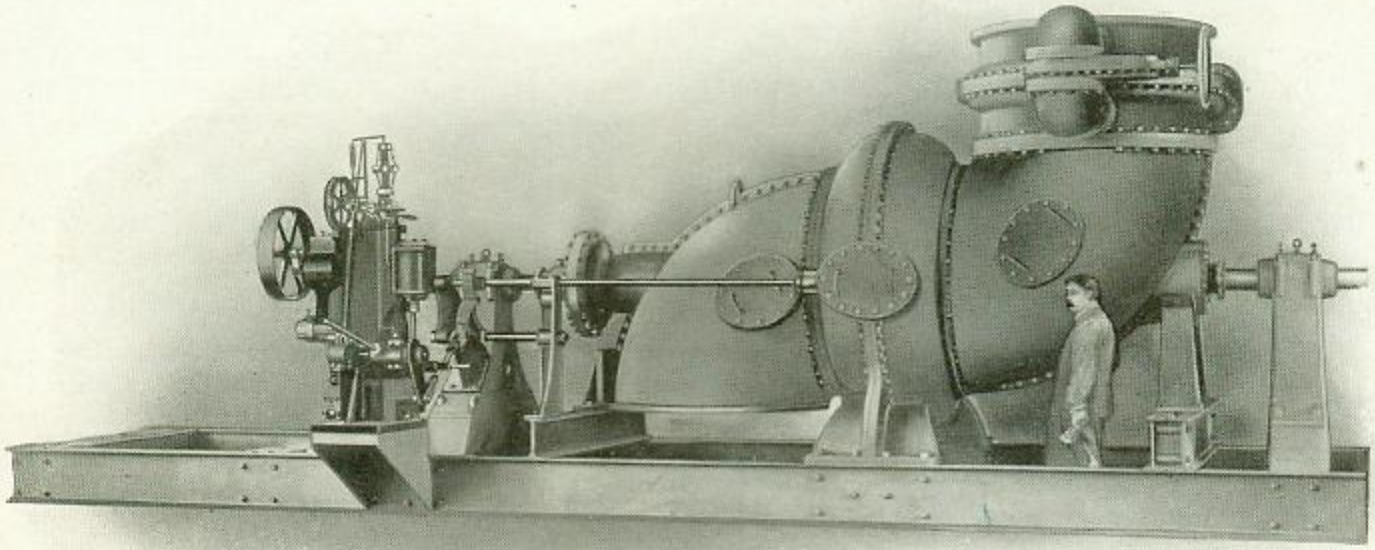
OUR PATENTED HIGH HEAD SCROLL TYPE TURBINES are without doubt the most efficient and durable built in this country and are equal in every respect to the Swiss Scroll Type. In addition to the scroll top which you will find illustrated on another page, we call your especial attention to our patented GATE OPERATING MECHANISM which is different from that used on any other turbine. It is durable beyond question and works easily under any head, has no link connections or bolts to become loose and give trouble, but is a mechanism that will last during the life of the turbine without repairs, requiring no attention whatever. The gates and all gate operating mechanism of this class of turbines are made of bronze; any gate can be removed in a few minutes without the use of any special tools—this we consider a very important feature.

Another important feature is our improved patented WATER CUSHION which we use on all single turbines both for high and medium heads. This Cushion takes care of all endthrust without wear and practically without friction; no wooden thrust bearings are used on any of our single turbines, we depend solely upon the Water Cushion which is not an untried device, hundreds of them being in use and giving the best of satisfaction, no matter what the gate opening may be or what type of governor is used the cushion can never come in contact with its seat, therefore there is no wear.

On all horizontal turbines we use the dynamo, ring-oiling ball and socket type of bearings, all filled with first-class babbitt peined to place and bored accurately to fit shaft.

These turbines are absolutely noiseless and work perfectly steady and smooth even under the highest heads, and the runners being perfectly balanced there is no vibration.

We build turbines to suit the conditions under which they are placed, to use the quantity of water at hand and to give the number of revolutions required by the generator or other machinery, and we make a specialty of building turbines of all capacities and speeds to suit various conditions.



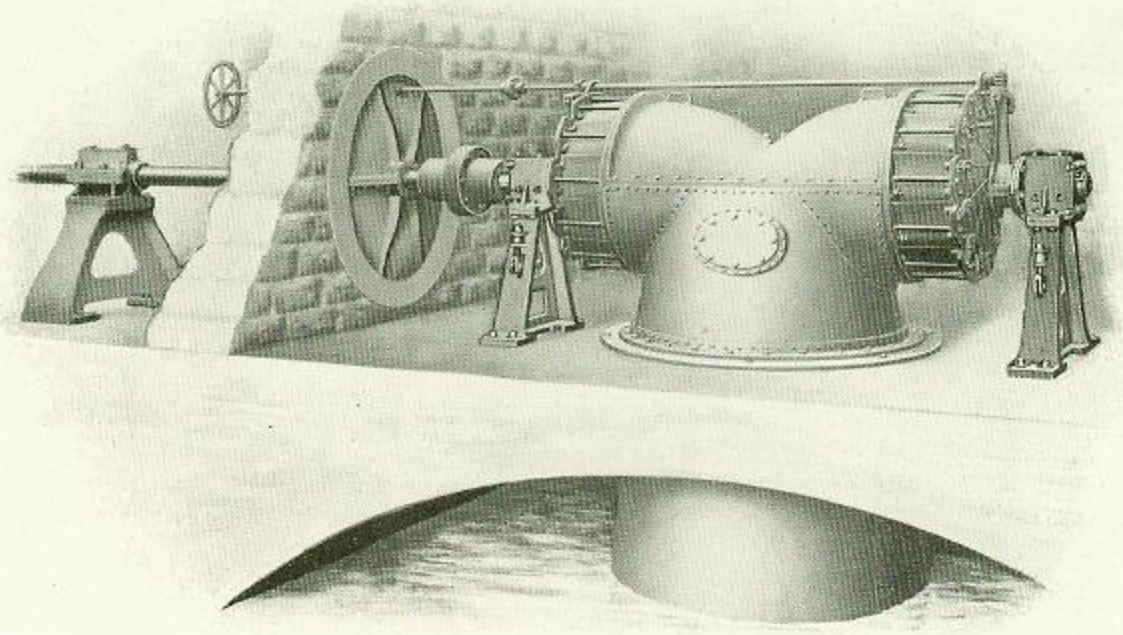
High Head Scroll Type Turbine

HORIZONTAL wheels for low or medium heads are usually placed on draft chests and erected in open penstocks, which can either be built of timber, stone or concrete. Wheels set in this manner give as good results as if placed in steel casing and are much less expensive. This style of wheel can be set under heads as high as thirty feet and by using a draft tube fifteen feet long, the penstock need only carry a pressure of fifteen feet head, the remaining head being obtained by the use of the draft tube.

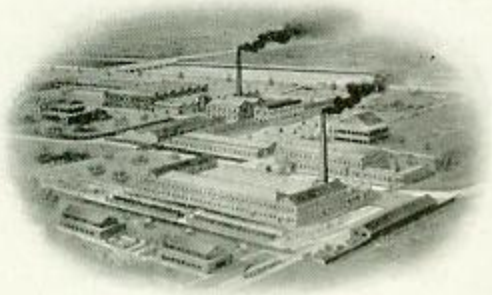
Our small wheels are placed on draft chests made of cast iron. Wheels larger and including 23-inch are placed on draft chests made partly of steel plate, the lower half of the chest being made of steel plate while the upper or removable half is made of cast iron, with adjustable table bearing in center adjustable from the outside.

Le turbine orizzontali per medie e basse cadute sono generalmente montate su tubi di aspirazione a gomito, come illustrato sulla pagina qui di fianco. Questi gomiti possono venir poi collocati in una camera libera costrutta in legno, in muratura o in calcestruzzo. In questo modo le turbine possono venir collocate sotto cadute fino di 10 metri facendo uso di tubi di aspirazione colleganti la turbina all'acqua di scarico di sotto. Le nostre turbine piccole sono montate su tubi a gomito d'aspirazione in ghisa, quelle grandi, su gomiti costrutti in lamiera d'acciaio con coperchio di ghisa amovibile.

Horisontala turbiner för låga eller medelhöga fall äro vanligen plaserade på sugtrummor och uppsatta i sumpar af timmer eller sten. Turbiner plaserade på detta sätt, gifva lika goda resultat, som vore de plaserade i stålhus, och äro mycket billigare. Dylika turbiner kunna plaseras under ända till 30 fots (=9.15 m.) fall. Använder man en sugtrumma 15 fot (=4.5 m.) lång, behöfver sumpen endast uppbära ett tryck af 15 fots fall. Återstoden af fallets kraft erhålles af sugtrumman.



Pair Turbines on Draft Chest



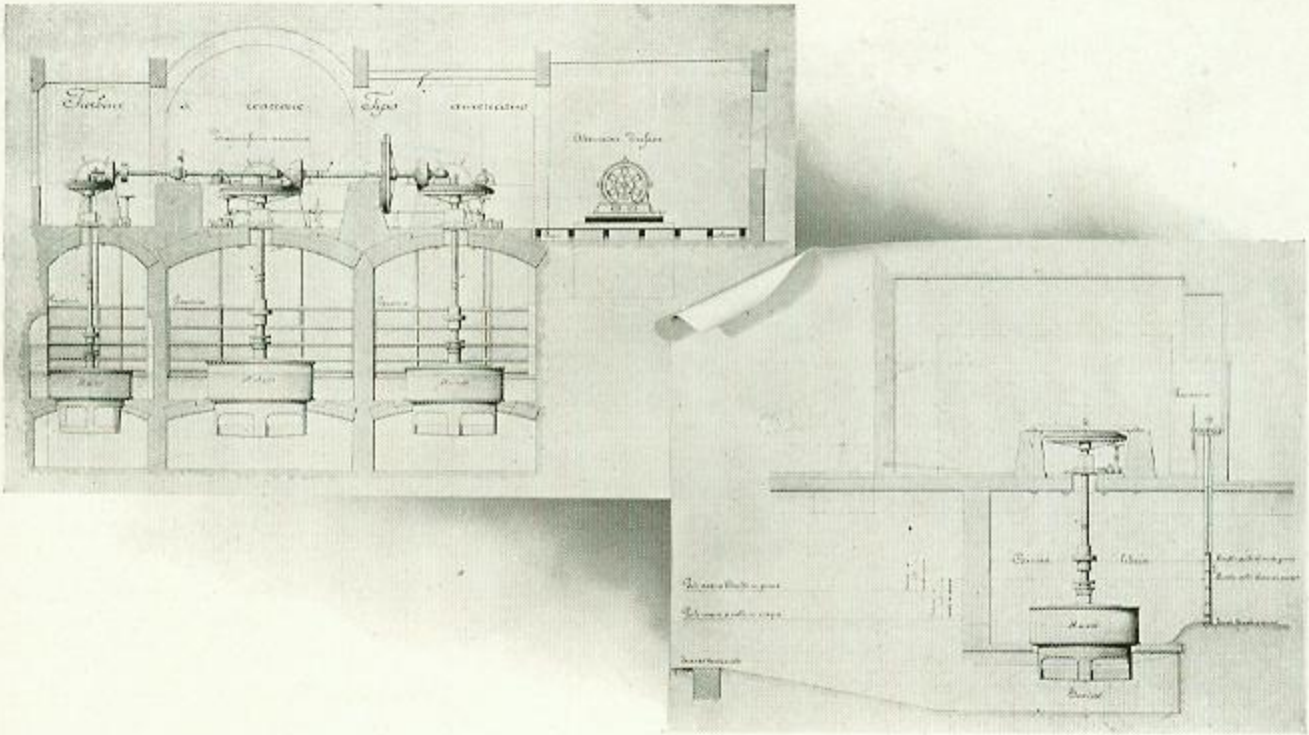
SPEAKING of low heads, the cut of drawing on opposite page shows three of our larger Turbines, 61, 56 and 44 inch, working under probably a lower head than any similar capacity Turbines in the world. These wheels are running in Italy, and our customer writes us that they are giving good results under a head as low as 26 inches. The cut is reproduced from an Italian drawing.

Should any of our customers be interested in low heads, we would be pleased to send them a reproduction of our customer's letter.

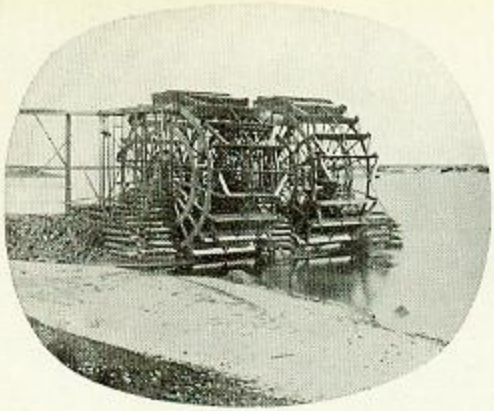
In order to have sufficient depth of water to cover the Turbines properly, it was necessary to set the wheels considerably below the level of the tail water. The drawing shows normal low water level.

Sulla pagina quì contro riproduciamo disegno d'impianto di tre grandi turbine Trump di 44, 56 e 61 pollici, in Italia. Questo disegno ci fu fornito dal nostro cliente italiano per mostrare le condizioni in cui le turbine sarebbero state collocate; si osservi che esse sono disposte sotto il livello dell'acqua nel canale di scarico. Il nostro cliente scrive che le turbine dànno buoni risultati sotto una caduta di soli 26" (m. 0,67). È per noi dubbio che vi possa essere nel mondo altra turbina di capacità press'a poco uguale e collocata sotto una caduta così bassa.

Äfven för ytterst låga fall kunna våra turbiner användas. På motsatta sidan visas trenne turbiner, 61,56 och 44 tum i diameter, hvilka drifvas af ett måhända lägre fall än turbiner af liknande storlek annorstädes i verlden. De äro uppställda i Italien och gifva goda resultat äfven för ett fall så lågt som 25 tum (660 m. m.) Afbildningen är från en italiensk ritning.



Stituto Ortopedico Rizzoli, Bologna, Italy



WE manufacture Horizontal Wheels in pairs where the power and speed required cannot be given with a single wheel.

The pair of wheels in steel casing, shown on opposite page, is from photo of a pair of our 48 inch wheels. A pair of Turbines of this size require a very large casing, being as large as can be shipped on the cars. Larger sizes are shipped in sections, the cases being riveted up on the ground where they are installed.

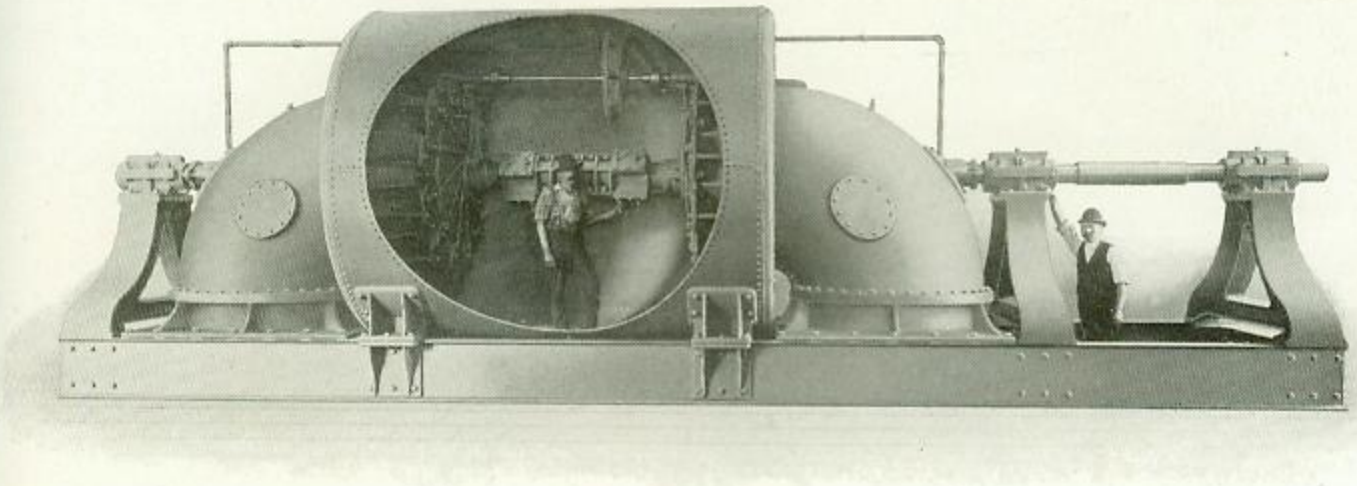
We also manufacture Horizontal Wheels as above, made to operate independently, so either one, or both, can be operated at one time, as the case may require, each wheel being supplied with an independent gate rigging. Where the wheels are required to be operated independently, each wheel is supplied with water-cushion.

Dove le condizioni sono tali che una turbina semplice non fornirebbe la forza richiesta collochiamo una coppia di turbine in una camera unica—come rappresentato nella pagina quì contro. L'incisione è ricavata da una fotografia di una coppia di nostre turbine di 48". Ove occorra, possiamo disporre le turbine operanti indipendentemente in modo che se ne può far funzionare una sola, oppure entrambe contemporaneamente, ogni turbina essendo munita di meccanismo distributore indipendente.

Vi tillverka horisontala turbiner i par, när den erforderliga kraften och hastigheten icke kunna erhållas medelst ett enda par.

På motsatta sidan visa vi en fotografi af ett par turbiner af 48 tums diameter i stålhus. Ett par turbiner af denna storlek fordra så storthus, som lämpligen kan forslas på en jernvägsvagn. Större storlekar sändas i delar, och hopnitas på platsen där de skola uppställas.

Vi tillverka äfven horisontala turbiner som ofvan nämda med själfständiga pådrag, så att antingen en eller båda kunna fås att operera.



Pair 44-inch Horizontal Turbines

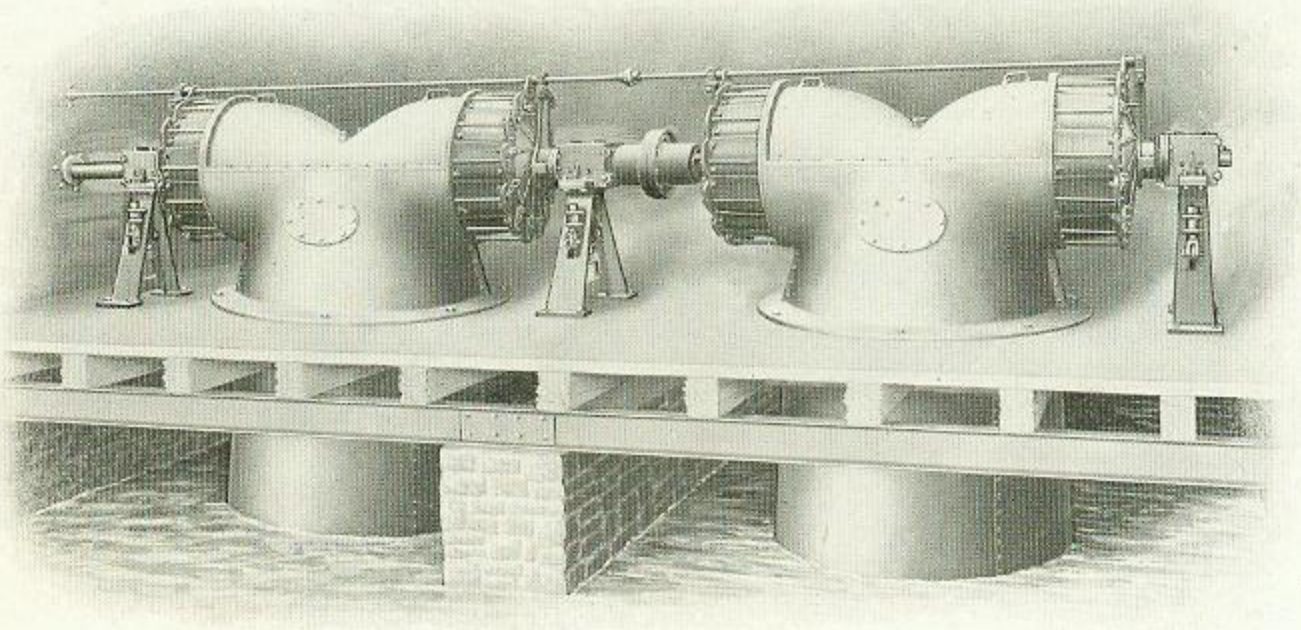
WHERE a large amount of power is required under a medium or low head, it is often advisable to use several pairs of wheels on draft-chests to obtain results. This is especially the case where a high speed is required, together with a large amount of power. In order to get the speed it is necessary to use a small diameter Turbine and to get the required power it becomes necessary to use several pairs in a line.

The cut on opposite page shows two pair in a line. Often three or more pairs are used. Where a long line is used it is very important to see that the wheels are kept perfectly in line, or a large amount of the power will be lost.

Quando si richiede una grande forza sotto una caduta media, è spesso consigliabile l'impiego di più turbine accoppiate sul medesimo asse, e ciò specialmente quando s'intende ottenere una forte velocità e una grande forza sotto una media caduta. L'illustrazione qui contro mostra due coppie di turbine sul medesimo asse. In molti casi vengono impiegate tre o più coppie di turbine per ottenere il risultato richiesto. Il rendimento delle turbine installate in questo modo è tanto grande come se esse fossero installate in camere di acciaio.

När stor kraft erfordras under lågt eller medelhögt fall, är det ofta rådligt att använda åtskilliga par turbiner med sugtrummor, för att erhålla goda resultat. Detta är synnerligen fallet om hastigheten är stor. I afsikt att erhålla den nödvändiga hastigheten, måste man använda turbiner med liten diameter; och för att erhålla den erforderliga kraften, måste man använda åtskilliga par hjul.

Afbildningen å motsatta sidan visar två par i linie. Ofta användas tre eller flera par.

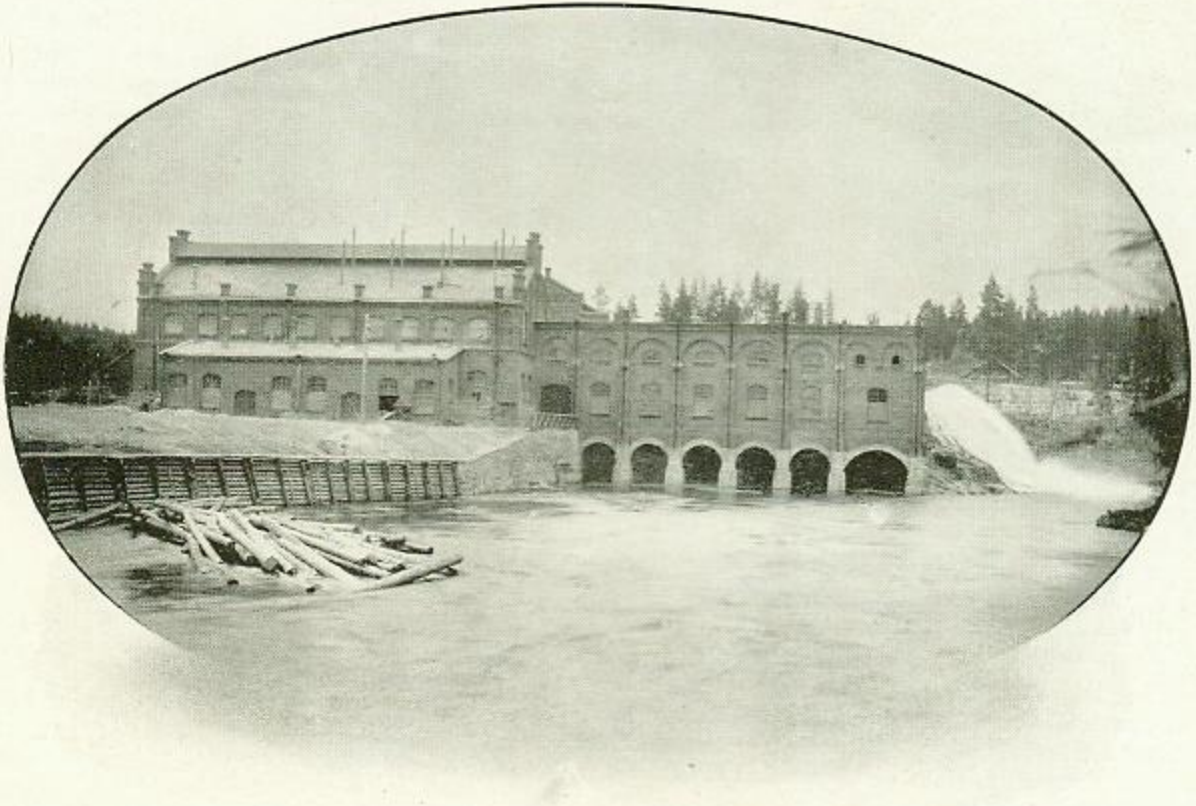


Two Pair Turbines on Draft Chests

SPEAKING of high speed Turbines, the only way to get a high speed is to reduce the diameter of the Runner. There is no possible way of increasing the speed of any Turbine and at the same time keeping up the efficiency by changing the shape of the buckets. All Turbines of the same diameter run at practically the same speed, so when you hear of a high speed Turbine giving a large amount of power and a high efficiency, beware, for you can only discharge a certain amount of water through a hole of a certain size. All good Turbines run at practically the same speed, considering the diameter. In other words, the difference in speed is not great. But when you see a Turbine tabled at a much higher speed than others and at the same time giving a large amount of power, you can make up your mind that there is something wrong.

Taluni costruttori di turbine dànno una velocità molto più alta di quanto diamo noi. Il solo mezzo di aumentare la velocità di qualunque turbina è quello di ridurne il diametro. Tutte le buone turbine, aventi uno stesso diametro, marciano, sotto una stessa caduta, ad una velocità praticamente identica, cioè la differenza di velocità è soltanto piccola. Perciò quando i nostri lettori vedessero in qualche tabella una turbina per la quale, a parità di caduta, fosse indicata una velocità maggiore che per altre turbine dello stesso diametro, dovrebbero ritenere che vi sia qualche sbaglio, oppure che il costruttore tenti d'ingannarli.

Önskas hastigt omlopp på en turbin, måste man reducera hjulets diameter. Det är omöjligt att öka turbinens hastighet och på samma gång hafva samma verkningsgrad, genom att ändra formen på skoflarne. Alla turbiner med samma diameter löpa med ungefär samma hastighet. När man hör om turbiner med hastigt omlopp, utvecklande stor kraft och gifvande hög verkningsgrad, bör man akta sig och ej blifva lurad, ty man kan endast afleda ett visst kvantum vatten genom ett visst hål. När man ser en turbin uppgifvas hafva mycket större hastighet, och på samma gång utveckla stor kraft, kan man vara fullt viss på att det ej står fullt rätt till.



Hameenkoski Aktiebolag, Finland

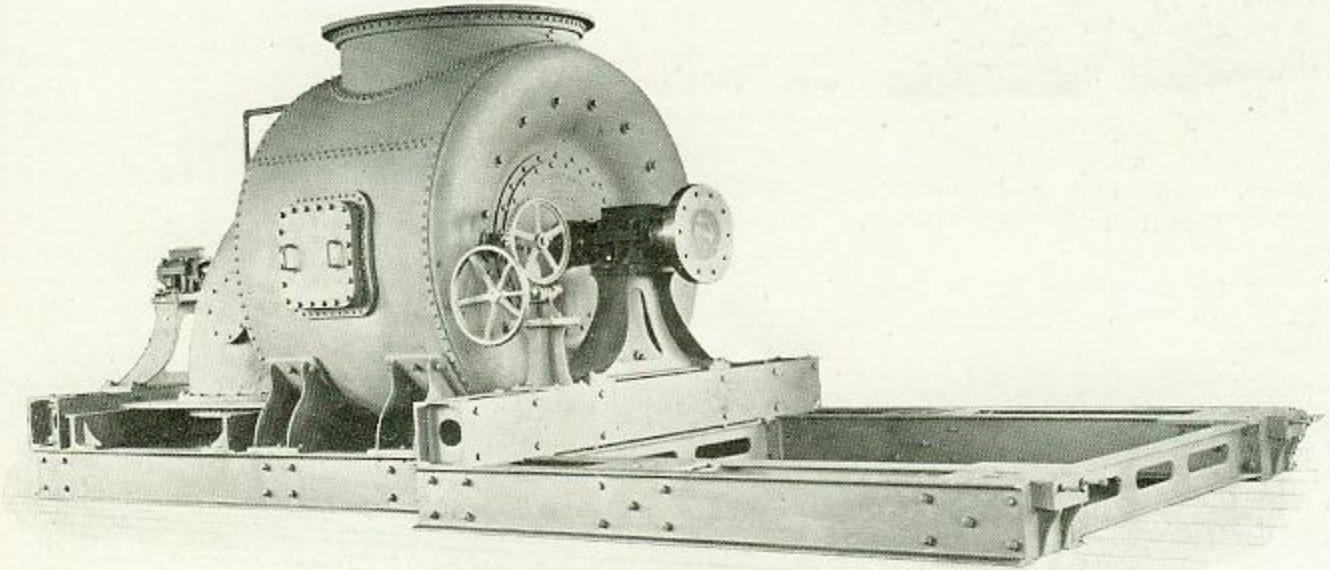
WE make a specialty of building Wheels for High Heads either Vertical or Horizontal, carrying the weight or end-thrust, without wear or friction, by using our Improved Patented Water Cushion. In fact, we are the only builders of a Single Horizontal Turbine which will work successfully under High Heads. We do not use wooden thrust bearings which are constantly wearing out, to say nothing of the power consumed by friction. As there is no end movement of the shaft, rigid face couplings can be used with safety. The cut on opposite page is from photograph of a 1200 horse-power Turbine now running under 95 feet head, being a Single Wheel with Cushion.

È nostra specialità la costruzione di turbine per alte cadute, sia del tipo verticale che orizzontale. Noi garantiamo che col nostro cuscinetto d'acqua (disco equilibratore) la spinta assiale della turbina dovuta al peso dei suoi organi ed alla pressione dell'acqua è sostenuta senza alcuna usura e frizione, a differenza dei perni di spinta delle turbine della concorrenza, i quali, essendo semplicemente in legno duro guajaco, si consumano rapidamente, dando luogo a seri inconvenienti. L'unico attrito, che risulta sul nostro cuscinetto, è causato da un disco piano girante nell'acqua, ma questo disco, non toccando la sede, non provoca alcuna usura. Facciamo uso il disco equilibratore soltanto sotto cadute di piú di 10 metri.

Diamo quì contro fotoincisione di una turbina semplice di 1200 H P lavorante sotto una caduta di 95 piedi (29 metri).

Våra turbiner för höga fall, både vertikala och horisontala, kunna förses med vår patenterade vatten-fjädring, hvarigenom vigten eller sidtrycket uppbäres utan friktion eller nötning. Ett faktum är, att vi äro de enda tillverkare af en enkel horisontal turbin, som arbetar fullt tillfredsställande under högt fall. Vi använda inga skiflager, hvilka jämt och ständigt förstöras genom nötning och förorsaka mycken förlust genom friktion. I vår konstruktion finnes ingen längdförskjutning af axeln och fasta kopplingar kunna användas utan fara.

Bilden på motsatta sidan visar en enkel turbin med vatten-fjädring utvecklande 1200 hästkrafter under ett fall af 95 fot (=28 m.)



1200 H. P. Turbine With Extended Base for Generator

WE manufacture wheels for over-land or mule-back transportation, the wheel-casing being made in sections so that no one piece will weigh over 250 pounds. Such wheels are used largely in the mining districts of Mexico and South America and are generally constructed for High Heads.

We also supply Iron Piping nested, punched and shaped ready for riveting, together with tools for erecting same on the ground.

We are prepared to furnish our medium size turbines, either the high or low head type, cut up in sections for over-land or mule-back transportation, and our high head turbines being much simpler in construction are less expensive when made in this manner than any other make of high head turbine of equal power and capacity.

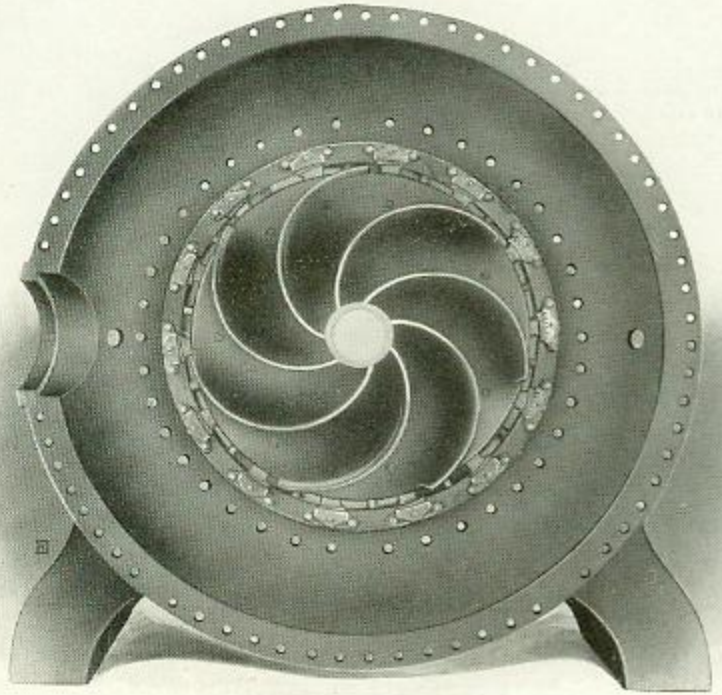
Fabbrichiamo pure turbine facilmente trasportabili per via terra, costrutte in sezioni di cui ogni pezzo non supera il peso di 125 Kg. Tali turbine sono largamente impiegate nei distretti minerari del Messico e Sud-America. Forniamo pure tubazioni di ferro ribadite e con briglie forate, cogli accessoried utensili, pronte per la posa in opera. Molte delle turbine a doppio scarico, illustrate sulla pagina qui contro, furono da noi costrutte in questo modo. Raccomandiamo ora, per questi impianti, le nostre turbine orrizzontali, semplici, che sono meno costose e più facili a installarsi, essendo tuttavia egualmente afficaci per alte cadute.

Vi tillverka turbiner, ämnade att transporteras med åsnor öfver land. Vid sådana tillfällen göras turbinhusen i delar, hvarje del af mindre än 250 skålpunds vigt (=114 kg.) Sådana hjul användas mycket inom grufdistrikten i Mexiko och Södra Amerika.

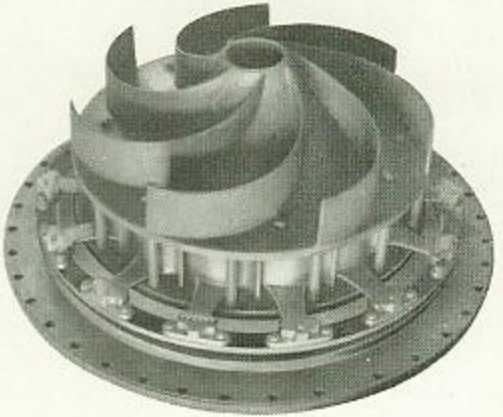
Vi leverera också jernrör, fullt färdiga att uppsättas jämte de dertill nödvändiga verktygen.

Vi hafva tillverkat många af våra dubbla aflopps-turbiner på detta sätt.

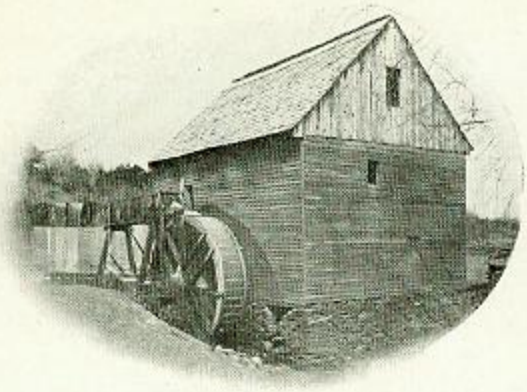
Våra enkla turbiner för höga fall kunna äfven leveras i mindre delar, när de skola forslas på detta sätt öfver berg. De äro mycket billigare och enklare.



Interior View of Scroll Type Showing Part of Outside Case



Showing Scroll Case

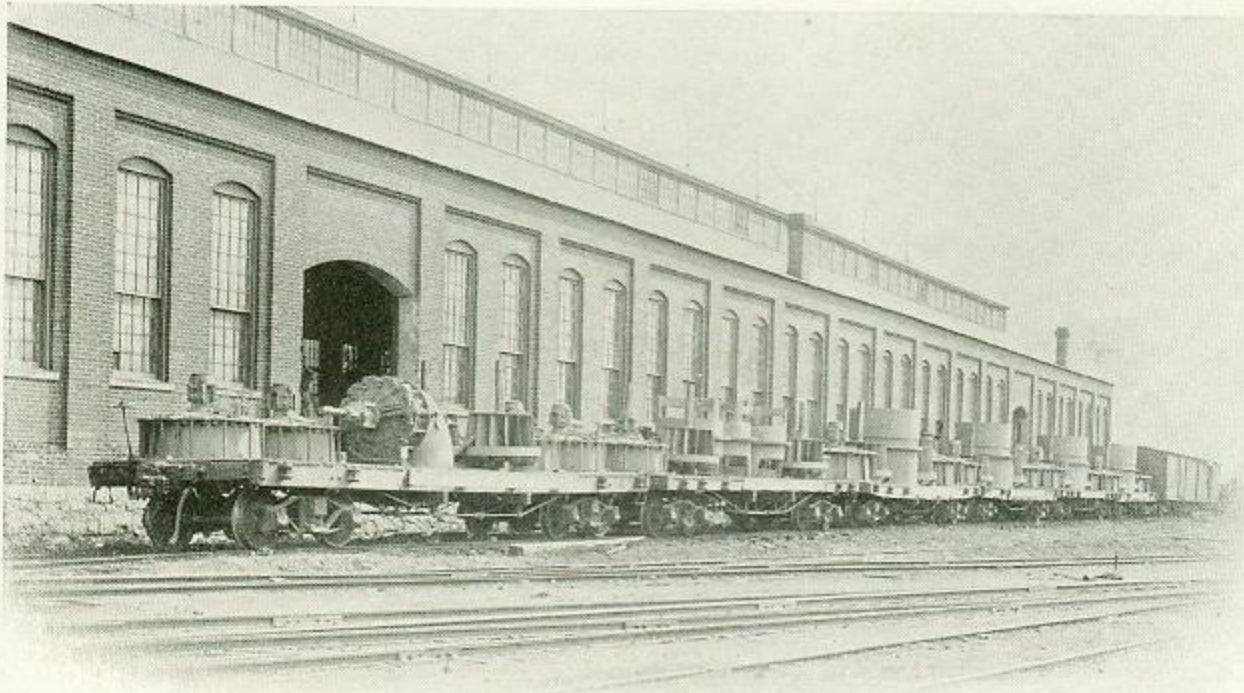


THE peculiar construction of our Runner makes it possible for us to use more water and at the same time get a higher efficiency, than is possible on any other make of wheel.

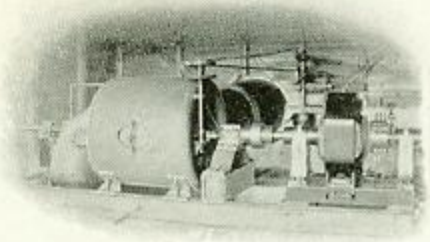
We measure our Wheels at the top and they taper 20 per cent.; hence a 40-inch turbine measures 48 inches at the discharge end. The wheel is not choked as many other large capacity wheels are. This feature is a great advantage on Horizontal Turbines as well as Vertical Wheels for low heads. The peculiar construction of the Runner gives direction to the water in the discharge, and under low heads is less affected by back water than any other Turbine.

La speciale costruzione della ruota mobile o girante della nostra turbina, rende possibile di smaltire una molto maggiore quantità d'acqua, ottenendo, nello stesso tempo, un rendimento più alto di quanto sia possibile raggiungere con qualunque altro tipo di girante. Noi misuriamo le nostre turbine alla sommità delle giranti. Queste hanno una conicità del 20% e quindi la parte inferiore è $\frac{1}{5}$ più grande della parte superiore. Cosicchè una turbina di 40" è 48" di diametro nella parte di sotto, ossia alla periferia di scarico. Con questa costruzione realizziamo un grande vantaggio, specialmente nelle turbine orizzontali. Anche dove le turbine sono collocate sotto piccole cadute, la forma della girante imprime la direzione all'acqua scaricantesi, evitando il rigurgito.

Konstruktionen af vårt krattnju. iståndsätter oss att använda mera vatten, och på samma gång erhålla större verkningsgrad, än hvad som är möjligt med någon annan turbin. Vi mäta våra turbiner vid toppen, och deras nedre del är ungefär en femtedel större. En 40 tums turbin mäter sålunda 48 tum vid afloppet. Hjulet dämmar icke vattnet såsom många andra större turbiner göra. Detta är en stor fördel i horisontella turbiner, äfvensom vid vertikala hjul för låga fall. Själfva turbinens ypperliga konstruktion gifver den rätta riktningen åt vattnet i afloppet och påverkas mindre af afloppsvattnet än andra turbiner.



Large Shipment on Our Siding



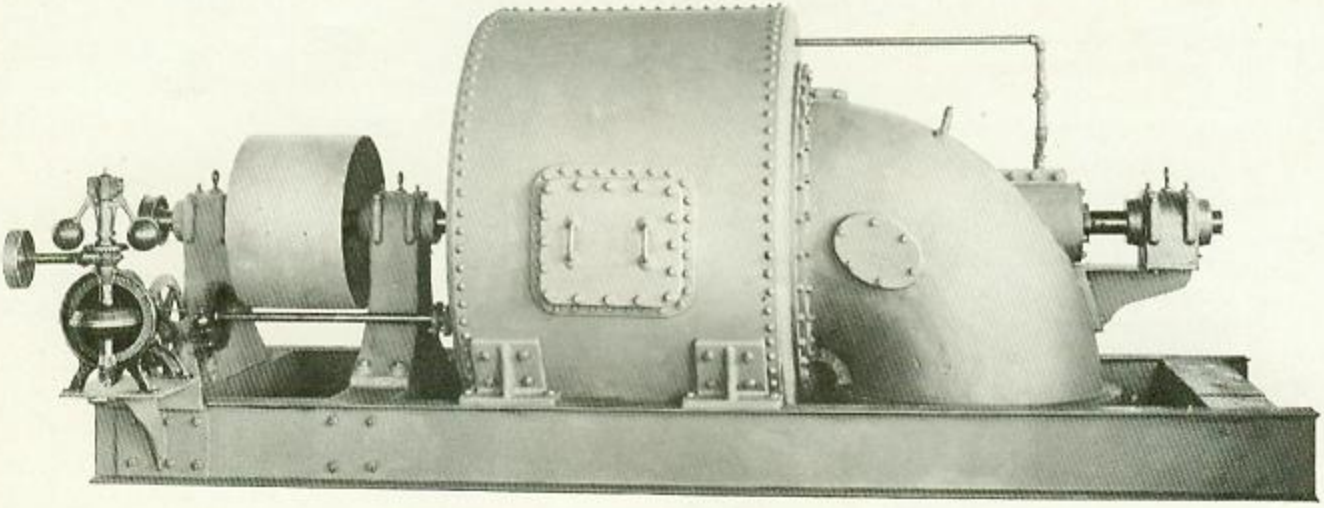
IN order to get the highest efficiency from a Turbine under a high head where steel tubing is used to conduct the water to the wheel, the tube should be large to avoid friction and the water should not pass through the tube at a greater velocity than five feet per second (300 feet per minute.) Take the area (cross section) of the pipe in feet, multiply this by 300 and you will get the number of cubic feet of water that the pipe will carry economically. If the pipe exceeds 100 feet in length, the velocity should be less than five feet per second.

The above rule applies to pipes of two feet in diameter and over.

Quando l'acqua è condotta alla turbina sotto alte cadute, per mezzo di tubazione di acciaio, per ottenere il massimo rendimento, il tubo dev'essere grande tanto da evitare la perdita di carico dovuta all'attrito dell'acqua nel tubo. L'acqua non dovrebbe passare attraverso il tubo con velocità maggiore di 2 metri per secondo; questo è il massimo, ma se il tubo eccede i 30 metri di lunghezza, la velocità dovrebbe essere molto minore. Moltiplicando la sezione del tubo per la velocità per secondo, si ottiene il volume d'acqua passante pel tubo. In molti casi sono state sciupate delle buone forze per deficienza nei diametri dei tubi delle condotte forzate alle turbine.

För att erhålla den största verkningsgraden i en turbin under högt fall, då stålrör användes att leda vattnet till turbinen, bör röret vara af stor diameter för att minska friktionen och vattnet bör ej passera genom röret med större hastighet än 1.5 m. per sekund (90 m. i min.) Om rörets längd är mer än 30 meter, bör hastigheten vara mindre än 1.5 meter per sekund.

Ofvanstående regel gäller för rör af 0.6 meter i diameter eller öfver.



Single Horizontal Turbine with Water Cushion

VERTICAL TURBINES DRIVING DIRECT-CONNECTED GENERATORS.

IN developing electrical plants it often becomes a question of economy, both in the use of water as well as the first cost of machinery. We claim that Generators driven as shown in cut on opposite page, are the most efficient and economical, provided the conditions are such that the required power and speed can be obtained from a single turbine under the head to be developed.

The advantages over the use of a horizontal turbine are as follows:

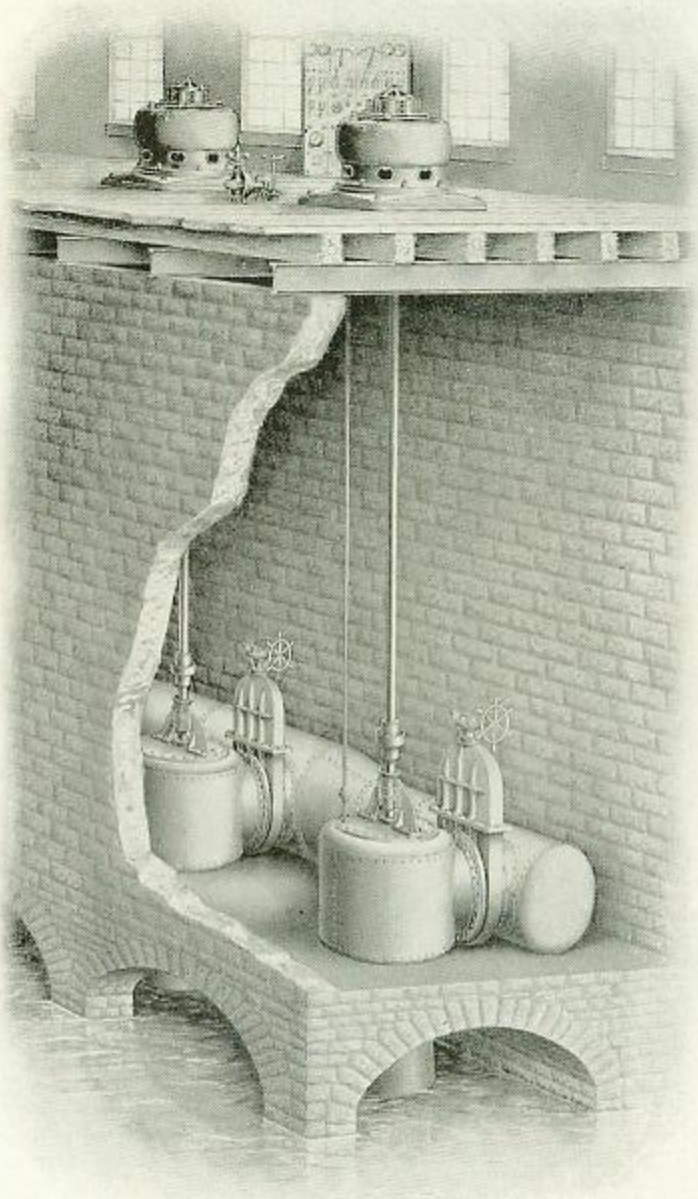
1st. A Vertical turbine of any make will give a better efficiency than a Horizontal one of the same capacity.

2nd. A Vertical turbine occupies less space and in many instances it is impracticable to use a direct-connected horizontal outfit, on account of the cramped conditions as to space etc.

3rd. In using a Vertical outfit you have but one vertical journal to take care of, hence the friction amounts to merely nothing. On a horizontal outfit you have several journals to look after which require constant attention.

4th. The first cost of Vertical turbine is less than a horizontal one to say nothing of the cost of excavating etc., in many cases to get sufficient room to place a horizontal outfit.

You naturally ask whether the step will not wear down and give trouble. In answer would say that we do not depend on a step to carry the load, we carry this on our improved patented automatic water cushion, which carries the entire load without wear or friction, the only friction is that caused by plain disc running in the water. This disc is fastened to turbine shaft, has no bearing on either side except water pressure on both faces. We guarantee to carry the weight to your satisfaction.



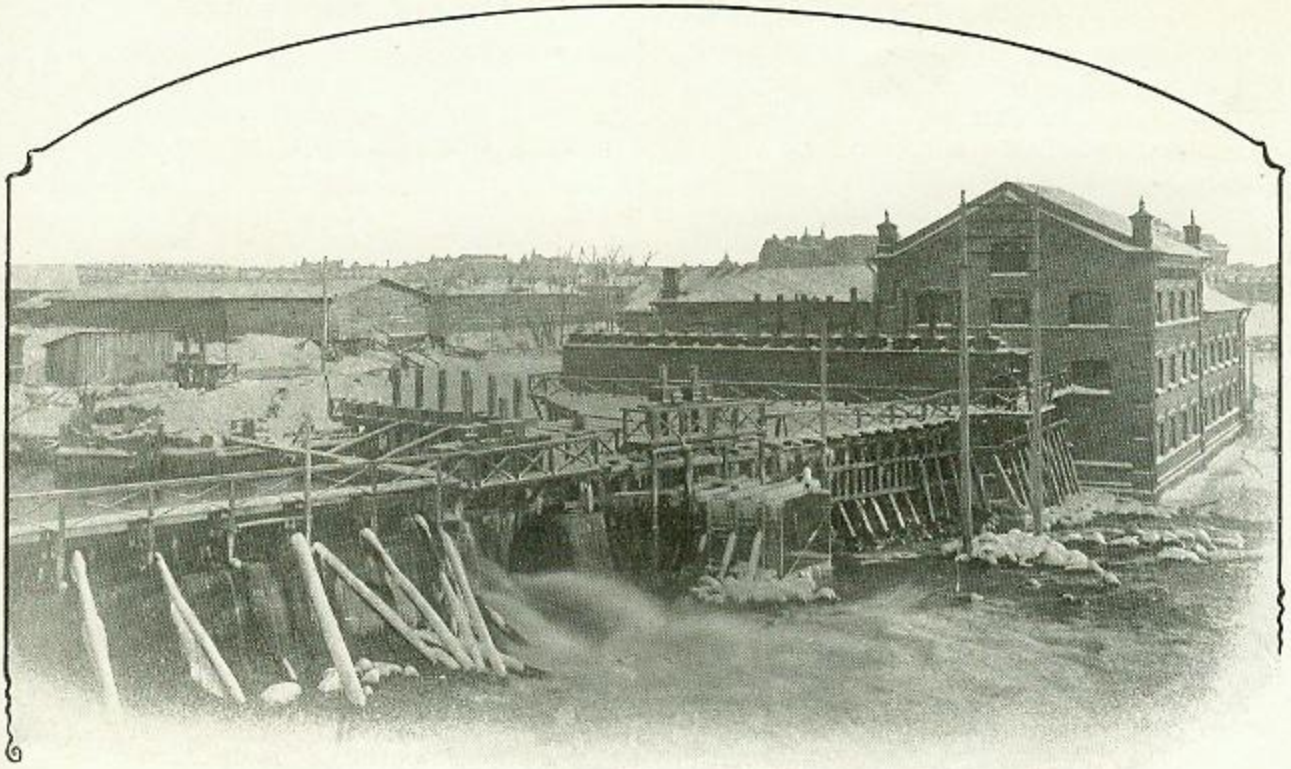
Generators Connected Direct on Top of Turbine Shaft

PARTIES DEVELOPING WATER POWER FOR ELECTRICAL PURPOSES.

WHEN a water power is to be developed for electrical purposes the most important feature is often overlooked at the start. Generally the manufacturers of Generators are first consulted.

For example: A 500 h. p. plant is to be developed and our water power owner finds he can get a generator that will make 800 r. p. m. for a certain amount of money, while a generator of the same capacity making but 400 r. p. m. costs a much higher figure. The generator manufacturer tells him that it does not matter which generator he buys as he will get the same efficiency from either, hence he contracts for the high speed or cheaper outfit. He then goes to the turbine builder and states he has bought a generator of a certain size making so many revolutions per minute and wishes a direct connected turbine equipment. The turbine builder tells him that he cannot give the high speed required without using a very small diameter turbine which will not give the power except at a low efficiency, therefore he finds that by the purchase of the cheaper generator it requires much more water to give him the power required than if he had considered the turbine at the start.

Always consult the turbine man first, state your conditions and he will give you the approximate speed at which you can get the best results under your head. Never use a small diameter turbine under a high head if you wish the best efficiency, unless you require but a limited amount of power.



Tammerfors Elektrichets Verk, Finland

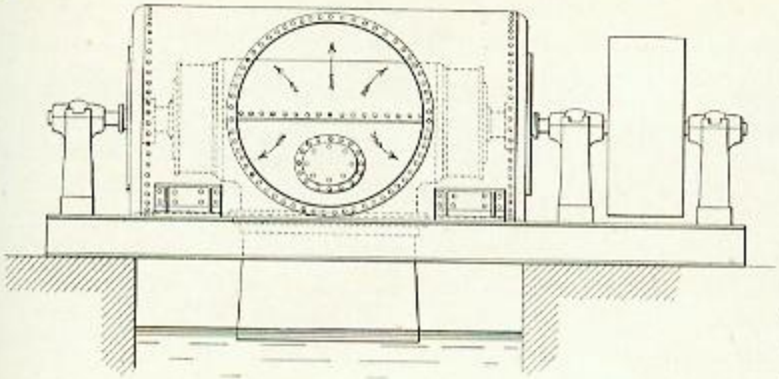
ENCASED HORIZONTAL TURBINES OF THE DRAFT CHEST TYPE.

HORIZONTAL turbines on draft chest set in an open flume will develop a good efficiency, but it does not follow that the same turbines placed on draft chest enclosed in a steel casing will give the same efficiency. A pair of turbines can be placed in an open flume, or even a long line of them, and give good results, for the reason that there is ample room for the water to enter each turbine without commotion or loss from counter-current, eddies, etc., which is not the case where the same turbines and draft chest are placed in a closed steel flume or penstock. Therefore, it is impossible to get as good an efficiency from encased turbines of this type as it is from turbines placed in open penstock with ample room on every side.

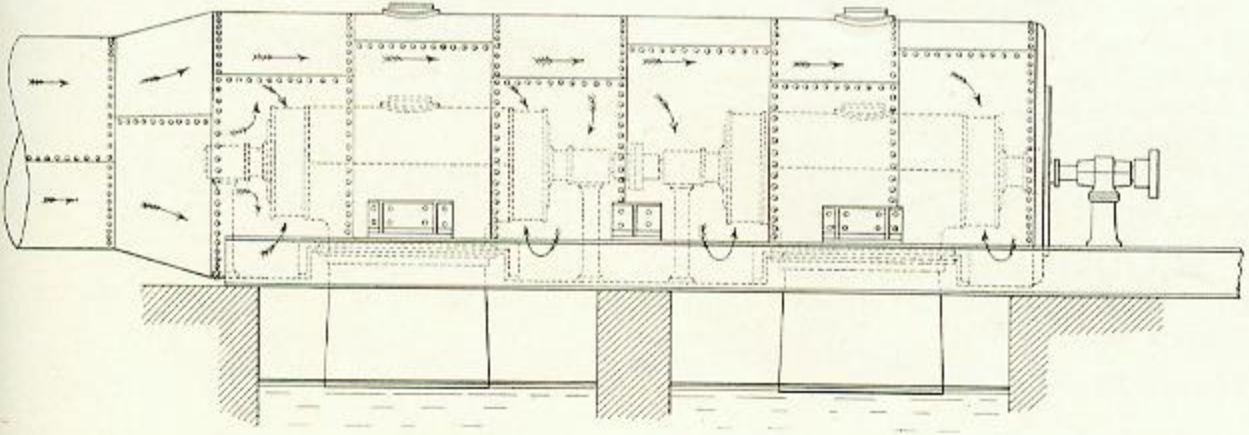
The proposition is bad enough when the water enters the penstock at the end as shown in cut on opposite page, but where the water enters through a side inlet or supply pipe coming directly opposite to the discharge chest of the turbines, then the efficiency must be very low, as the velocity of the water is in check long before it reaches the runner. Thus, it is impossible to get even a fair efficiency with this type of setting. A great many turbines have been sold set in this manner, but we are satisfied that none of them give even a fair efficiency. It is contrary to all hydraulic rules to reduce the velocity of the water before it reaches the runner, and it will be readily seen that the loss of efficiency in an installation of this kind is enormous. We do not recommend or build turbines of the design shown on opposite page unless the location demands it and it is impossible to use any other type of installation. It is always understood, however, that if the turbines are set in this manner that the efficiency will be low.

Another trouble with this type of installation is that the turbines are difficult not only to erect but to get at in case anything should go wrong. We advise our customers to look into this matter carefully before considering an installation of either of the above types. The setting is not at all suitable for high heads, and is only used under medium heads.

On all turbines of the Draft Chest type we use our patented Journal Box, which will last during the life of the turbine. It is a pivoted box, and the shaft can be kept in absolute line without letting the water out of the penstock or going inside at any time. There are no set-screws to adjust, neither is there any lining up necessary. The special feature of the box is an aligning arrangement, which we would be pleased to take up with any of our customers and describe at length.



These drawings show a very poor type of installation and if the best turbine built is set as shown in cut, it will give a very low efficiency. Follow the arrows and note the circuitous route the water takes before reaching the runners, the velocity of the water cannot be checked or broken without great loss in efficiency. Never put in an installation of this kind unless the location will not admit of a better design.

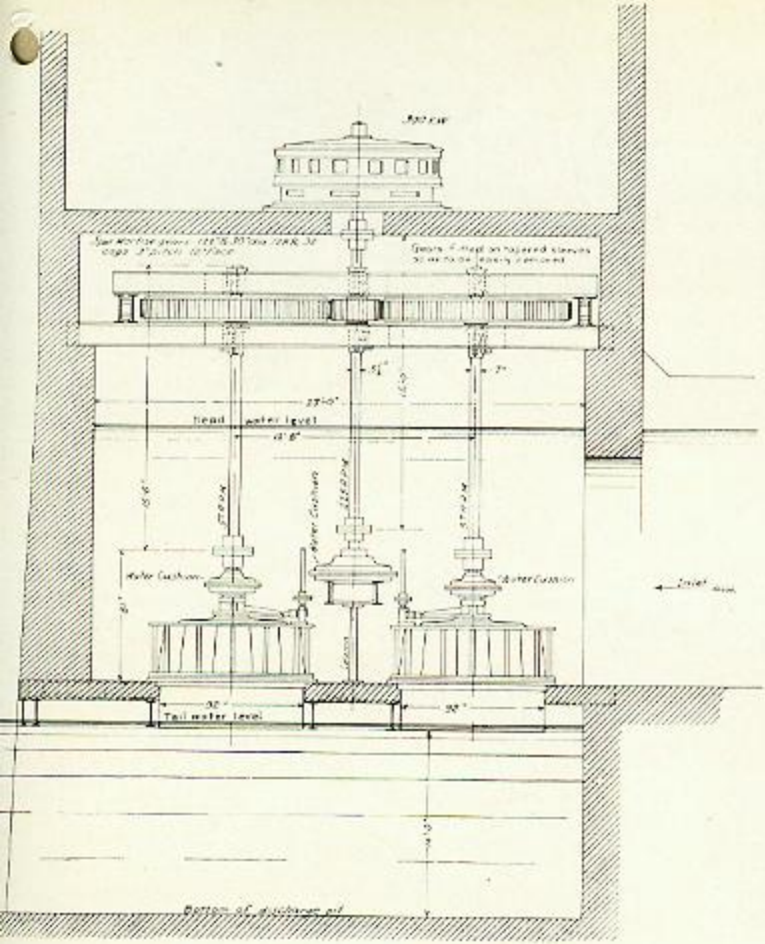


DRIVING GENERATORS AND CENTRIFUGAL PUMPS—UNDER LOW HEADS.

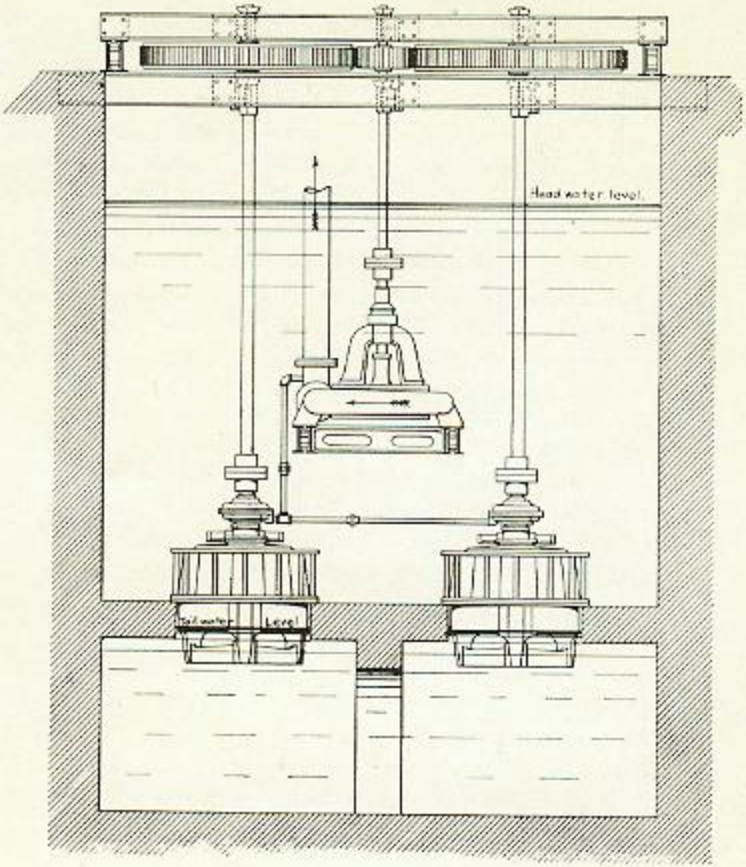
TURBINES are largely used for driving centrifugal pumps for irrigating purposes, the power being obtained from turbines placed under low heads, and in order to obtain sufficient speed for pumps either bevel or spur gear is used. The frictional loss of power when bevel gearing is used is great, in fact there is a loss of from 20 to 30% of the actual power given by the turbine, the loss being governed largely by the ratio of the gearing used, and in no event should the ratio of the gears be greater than 3 to 1. Hence it is difficult to obtain sufficient speed under low heads to drive a pump without using a large diameter pump, which is expensive to say nothing of the frictional loss of power and the wear of the bevel gears. On the other hand, if spur gearing is used the frictional loss is not over one-half as great and the life of a spur gear over a bevel gear is fully double as great considering the amount of power to be transmitted. It is a difficult matter to keep bevel gears in perfect pitch owing to the fact that the least wear on the turbine step lowers the gear and throws it out of pitch, which is not the case where spur gears are used.

The coming generator for all Hydro Electric plants is of the vertical or "umbrella" type, especially for low and medium heads. Under low heads at least 30 per cent of the water used is wasted when a standard horizontal generator is used and the power transmitted through bevel gearing. If spur gearing is used a much higher speed can be obtained and the cost of generator is thereby greatly reduced, as it is impossible to obtain as high speed under the same conditions with bevel gears as it is with spur gears. With a spur gear driven generator you have a perfectly smooth running job, one which runs without vibration, the pitch lines always being together as there is no dead weight to be carried on the journals, the journals being merely used to keep the gears in proper position and will wear indefinitely.

You may naturally ask—How we support all this weight? This we do with the use of our automatic Water Cushion which carries the weight perfectly, and which we guarantee to the fullest extent. Under an extreme low head where you do not have sufficient water pressure to counter-balance the weight, we use a small centrifugal pump to furnish pressure, and the cushion requires but a small amount of water and a limited amount of power to carry the weight perfectly. Where the head is 10 feet and upward we can carry the weight with the water pressure due to the head under which the turbine is placed.



Vertical Generator Installation



Vertical Pump Installation

HORIZONTAL TURBINE INSTALLATIONS.

THE efficiency of any turbine depends largely upon the manner in which it is installed, also the manner in which the gates deliver the water to the turbine runner. This is a very important feature that is overlooked by many turbine builders. On our High Head turbines we design special shaped gates for each runner of a certain capacity, so as to obtain the best possible efficiency at all stages of gate opening down to less than one-half gate. On Standard turbines for low and medium heads we use a standard gate and a standard runner which is built to develop the power and speed as tabled in Catalog under the various heads. With a High Head turbine the proposition is different, as the manufacturers usually are called upon to design a turbine to use a certain quantity of water under a given head so as to give the highest possible efficiency; then the turbine is usually built to give a certain speed to suit the revolutions required by the generator or other machinery; therefore all such turbines must be designed to suit the conditions.

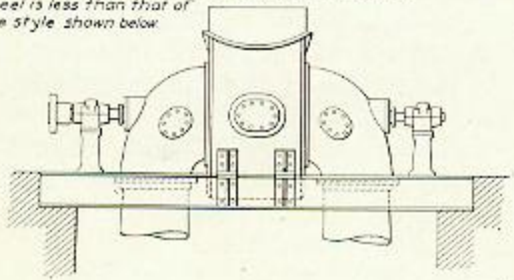
In placing a turbine in the ordinary type of steel casing with a side inlet it is impossible to get the efficiency that you would from the same turbine placed in a casing where the water enters parallel with the shaft. Where the water enters the turbine from the side or at right angles to the shaft, you will find that the water enters the gates direct on one side, while on the other side there is a counter-current, which lessens the efficiency. (See cut on opposite page). The water should enter the turbine runner without commotion, and for this reason the TRUMP SCROLL TYPE is the most efficient, as the velocity of the water is not lessened until it reaches the runner and enters all the gates of the turbine at the same velocity and without any commotion whatever.

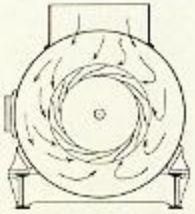
We formerly built what was termed a Double Discharge turbine, but of late years have dropped this class, owing to the fact that they wear to one side of the casing, causing a great deal of leakage and soon become unbalanced. There is no Double Discharge turbine that will run to exceed two or three years without requiring the casing to be bushed around where the runner revolves. The runner in this class of turbines always wear to one side, owing to the pressure being more direct on one side than it is on the other. Study opposite page carefully.

ORDINARY WAY.

DOUBLE DISCHARGE TYPE.

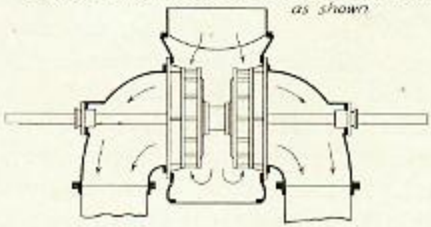
This design shows the ordinary method of horizontal turbine construction. Wheels of this type give fair results under medium heads providing steel casings of ample size. However experience has demonstrated that under high heads the efficiency of this type of wheel is less than that of the style shown below.





The arrows in the above show the direction of the currents of water as they enter the gates and runner of the turbine. It is readily seen that the currents which reverse as shown on the right hand side cause an unequal pressure.

In turbines of this type under high heads where the pressure of water is great the runner wears to one side causing leakage and ultimate failure. This wearing to one side is caused by an unequal pressure of water on the runner due to the counter-currents as shown.

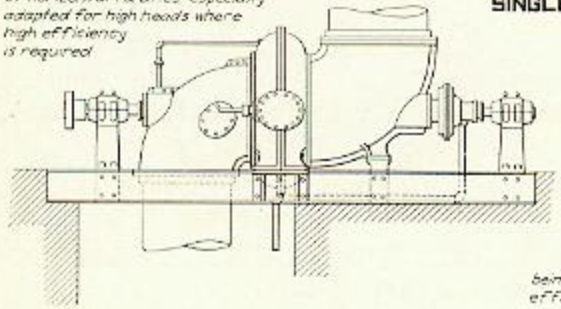


There is always more or less end movement of shaft in this type of turbines under high heads.

IMPROVED WAY.

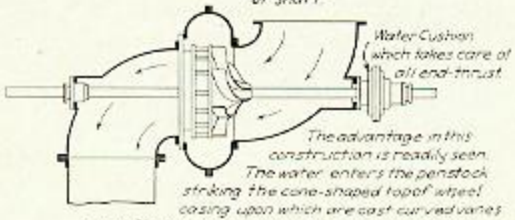
SINGLE DISCHARGE TYPE.

This design shows the latest improved methods used and patented by THE TRUMP MFG. Co in the construction of horizontal turbines especially adapted for high heads where high efficiency is required.



The arrows in the above show the uniform direction of the currents of water. Pressure being equal on all sides, the highest possible efficiency is obtained.

The end-thrust of this type of turbine is automatically balanced by our patented automatic Water Cushion which allows no end movement of shaft.



The advantage in this construction is readily seen. The water enters the penstock striking the cone-shaped top of wheel casing upon which are cast curved vanes to deflect the water without commotion, setting it in a uniform circular motion around the gates thereby giving an equal direct pressure on all sides.

Showing Old, Also Improved Types

UP-TO-DATE TURBINES.

OUR Company manufactures turbines to suit the various conditions under which they are placed. We build Standard Trump turbines for low and medium heads or heads from 4 to 40 feet, and our High Head Scroll type turbines for high heads. All high head turbines are built special to suit the conditions under which they are placed. Give us the head that the turbine is to be placed under, quantity of water at hand, and speed you wish turbine to run, and we will furnish a wheel which we guarantee to give you 80% efficiency. This cannot be done with a turbine as usually built and set in a standard steel casing. The only horizontal turbine that will really give 80% efficiency is the Scroll type, either the Swiss or the Trump scroll type of casing. The style casing in which the turbine proper is placed has everything to do with the efficiency. The Swiss scroll type is all right but is too expensive, especially when the Trump Scroll type will give as high efficiency as is possible to get from the Swiss Type.

And again, the Gate Mechanism is far ahead of that used by any other turbine of the high head class. There are no bolts to become loose, no links to rattle and wear out. Our Gate Mechanism is the last part that will wear out or give you trouble.

We claim to build the only strictly up-to-date turbine and accessories built in this country, and as proof of this kindly examine the various turbines and see if you can find any improvements which have been made within the last 15 years.

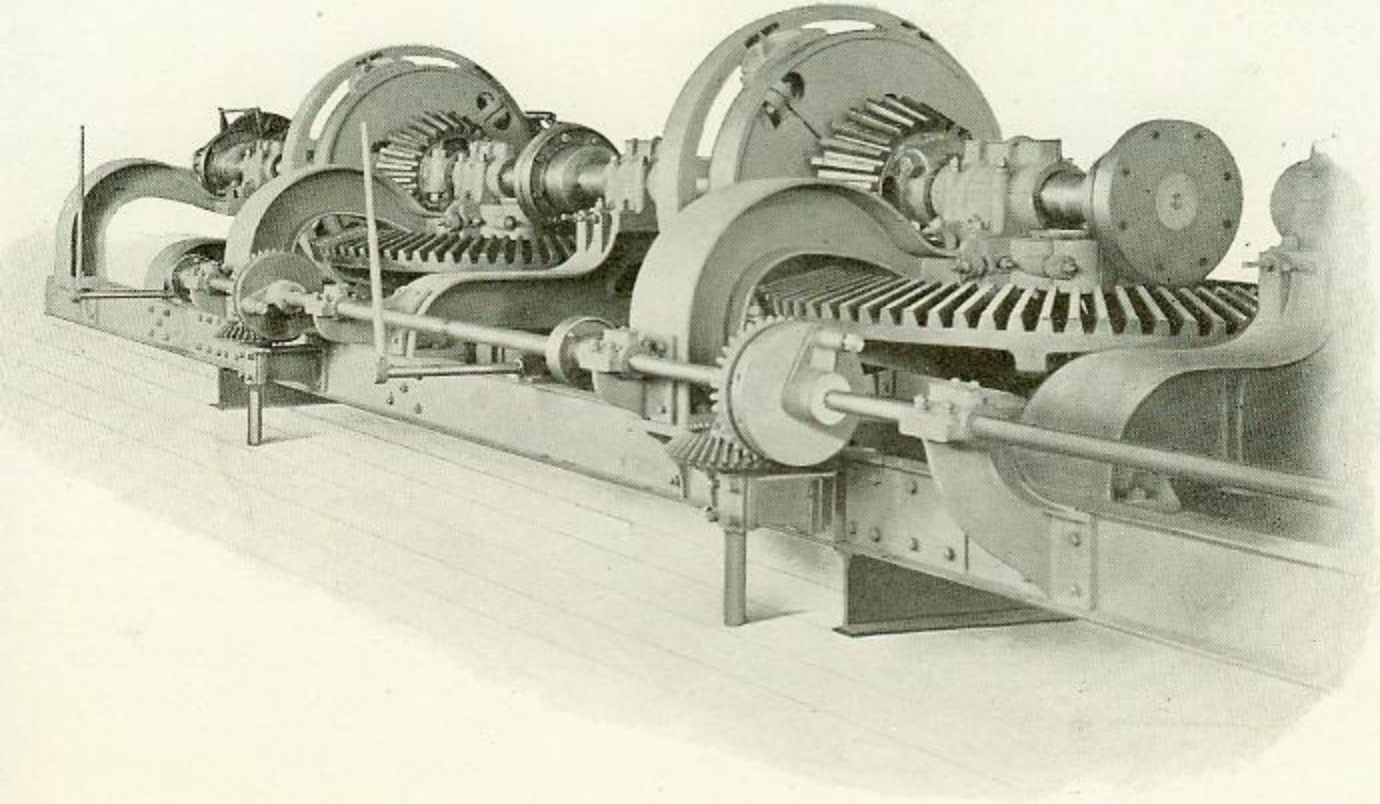
We will quote on whatever you want and guarantee the job we quote.

For HEAD GATE JACKS, FLUME AND SLUICE VALVES, TRASH RACKS, GEARING AND SHAFTING, or anything special in the turbine line, let us hear from you.

TABLE OF METERS SHOWING EQUIVALENT IN ENGLISH FEET AND INCHES.

METERS	EQUIVALENT IN ENGLISH FEET AND INCHES	METERS	EQUIVALENT IN ENGLISH FEET AND INCHES	METERS	EQUIVALENT IN ENGLISH FEET AND INCHES	METERS	EQUIVALENT IN ENGLISH FEET AND INCHES	METERS	EQUIVALENT IN ENGLISH FEET AND INCHES	METERS	EQUIVALENT IN ENGLISH FEET AND INCHES
2	6 ft. 6 in.	10	32 ft. 9 in.	18	59 ft.	26	85 ft. 3 in.	34	111 ft. 6 in.	42	137 ft. 9 in.
2.25	7 ft. 4 in.	10.25	33 ft. 7 in.	18.25	59 ft. 10 in.	26.25	86 ft.	34.25	112 ft. 4 in.	42.25	138 ft. 7 in.
2.50	8 ft. 2 in.	10.50	34 ft. 5 in.	18.50	60 ft. 6 in.	26.50	86 ft. 11 in.	34.50	113 ft. 2 in.	42.50	139 ft. 4 in.
2.75	9 ft.	10.75	35 ft. 3 in.	18.75	61 ft. 6 in.	26.75	87 ft. 9 in.	34.75	114 ft.	42.75	140 ft. 2 in.
3	9 ft. 10 in.	11	36 ft. 5 in.	19	62 ft. 4 in.	27	88 ft. 6 in.	35	114 ft. 9 in.	43	141 ft.
3.25	10 ft. 8 in.	11.25	36 ft. 10 in.	19.25	63 ft. 1 in.	27.25	89 ft. 4 in.	35.25	115 ft. 7 in.	43.25	141 ft. 10 in.
3.50	11 ft. 5 in.	11.50	37 ft. 8 in.	19.50	63 ft. 11 in.	27.50	90 ft. 2 in.	35.50	116 ft. 5 in.	43.50	142 ft. 8 in.
3.75	12 ft. 3 in.	11.75	38 ft. 6 in.	19.75	64 ft. 9 in.	27.75	91 ft.	35.75	117 ft. 3 in.	43.75	143 ft. 6 in.
4	13 ft. 1 in.	12	39 ft. 4 in.	20	65 ft. 7 in.	28	91 ft. 10 in.	36	118 ft. 1 in.	44	144 ft. 4 in.
4.25	13 ft. 11 in.	12.25	40 ft. 1 in.	20.25	66 ft. 5 in.	28.25	92 ft. 8 in.	36.25	118 ft. 11 in.	44.25	145 ft. 2 in.
4.50	14 ft. 9 in.	12.50	41 ft.	20.50	67 ft. 3 in.	28.50	93 ft. 6 in.	36.50	119 ft. 9 in.	44.50	145 ft. 11 in.
4.75	15 ft. 7 in.	12.75	41 ft. 9 in.	20.75	68 ft.	28.75	94 ft. 3 in.	36.75	120 ft. 6 in.	44.75	146 ft. 9 in.
5	16 ft. 4 in.	13	42 ft. 7 in.	21	68 ft. 10 in.	29	95 ft. 1 in.	37	121 ft. 4 in.	45	147 ft. 7 in.
5.25	17 ft. 2 in.	13.25	43 ft. 6 in.	21.25	69 ft. 8 in.	29.25	95 ft. 11 in.	37.25	122 ft. 2 in.	45.25	148 ft. 5 in.
5.50	18 ft.	13.50	44 ft. 3 in.	21.50	70 ft. 5 in.	29.50	96 ft. 10 in.	37.50	123 ft.	45.50	149 ft. 3 in.
5.75	18 ft. 10 in.	13.75	45 ft. 1 in.	21.75	71 ft. 4 in.	29.75	97 ft. 7 in.	37.75	123 ft. 10 in.	45.75	150 ft. 1 in.
6	19 ft. 8 in.	14	45 ft. 11 in.	22	72 ft. 2 in.	30	98 ft. 5 in.	38	124 ft. 8 in.	46	150 ft. 11 in.
6.25	20 ft. 5 in.	14.25	46 ft. 9 in.	22.25	72 ft. 11 in.	30.25	99 ft. 3 in.	38.25	125 ft. 5 in.	46.25	151 ft. 8 in.
6.50	21 ft. 3 in.	14.50	47 ft. 6 in.	22.50	73 ft. 9 in.	30.50	100 ft.	38.50	126 ft. 3 in.	46.50	152 ft. 6 in.
6.75	22 ft. 1 in.	14.75	48 ft. 4 in.	22.75	74 ft. 7 in.	30.75	100 ft. 10 in.	38.75	127 ft. 1 in.	46.75	153 ft. 4 in.
7	22 ft. 11 in.	15	49 ft. 2 in.	23	75 ft. 5 in.	31	101 ft. 8 in.	39	127 ft. 11 in.	47	154 ft. 2 in.
7.25	23 ft. 9 in.	15.25	50 ft.	23.25	76 ft. 3 in.	31.25	102 ft. 6 in.	39.25	128 ft. 9 in.	47.25	155 ft. 1 in.
7.50	24 ft. 7 in.	15.50	50 ft. 8 in.	23.50	77 ft. 1 in.	31.50	103 ft. 4 in.	39.50	129 ft. 7 in.	47.50	155 ft. 10 in.
7.75	25 ft. 5 in.	15.75	51 ft. 8 in.	23.75	77 ft. 11 in.	31.75	104 ft. 1 in.	39.75	130 ft. 4 in.	47.75	156 ft. 7 in.
8	26 ft. 2 in.	16	52 ft. 5 in.	24	78 ft. 8 in.	32	104 ft. 11 in.	40	131 ft. 2 in.	48	157 ft. 5 in.
8.25	27 ft.	16.25	53 ft. 3 in.	24.25	79 ft. 6 in.	32.25	105 ft. 9 in.	40.25	132 ft.	48.25	158 ft. 1 in.
8.50	27 ft. 10 in.	16.50	54 ft. 1 in.	24.50	80 ft. 3 in.	32.50	106 ft. 7 in.	40.50	132 ft. 10 in.	48.50	159 ft. 1 in.
8.75	28 ft. 8 in.	16.75	54 ft. 11 in.	24.75	81 ft. 2 in.	32.75	107 ft. 5 in.	40.75	133 ft. 8 in.	48.75	159 ft. 11 in.
9	29 ft. 6 in.	17	55 ft. 9 in.	25	82 ft.	33	108 ft. 3 in.	41	134 ft. 6 in.	49	160 ft. 9 in.
9.25	30 ft. 3 in.	17.25	56 ft. 7 in.	25.25	82 ft. 10 in.	33.25	109 ft. 1 in.	41.25	135 ft. 4 in.	49.25	161 ft. 6 in.
9.50	31 ft. 2 in.	17.50	57 ft. 4 in.	25.50	83 ft. 7 in.	33.50	109 ft. 11 in.	41.50	136 ft. 1 in.	49.50	162 ft. 4 in.
9.75	31 ft. 11 in.	17.75	58 ft. 2 in.	25.75	84 ft. 5 in.	33.75	110 ft.	41.75	136 ft. 11 in.	49.75	163 ft. 2 in.

INDEX TO SMALL CUTS.



Harness and Gearing