E. H. Bader, dear

Thompson does not understand your reply. There is no sign of installed tees on South extensions, whether bell or spigot.

Day letter collected.

This is in response to another call from Interstate.

July 17, 1935
3:50 P.M.
Send the following message, subject to the terms on back hereof, which are hereby agreed to.

June 17, 1935.

E. H. Bader,
Fort Lewis School,
Hesperus, Colorado.

No record size of tees on south line stop wire Thompson size and whether spigot or bell stop spigot has rolled bead.

Code

Day letter - collect.

THE QUICKEST, SUREST AND SAFEST WAY TO SEND MONEY IS BY TELEGRAPH OR CABLE
ALL MESSAGES TAKEN BY THIS COMPANY ARE SUBJECT TO THE FOLLOWING TERMS:

To guard against mistakes or delays, the sender of a message should order it repeated, that is, telegraphed back to the originating office for comparison. For this, one-half the unrepeated message rate is charged in addition. Unless otherwise indicated on its face, this is an unrepeated message and paid for as such, in consideration whereof it is agreed between the sender of the message and this company as follows:

1. The company shall not be liable for mistakes or delays in the transmission or delivery, or for non-delivery, of any message received for transmission at the unrepeated-message rate beyond the sum of five hundred dollars, nor for mistakes or delays in the transmission or delivery, or for non-delivery, of any message received for transmission at the repeated-message rate beyond the sum of five thousand dollars, unless specially valued; nor in any case for delays arising from unavoidable interruption in the working of its lines; nor for errors in cipher or obscure messages.

2. In any event the company shall not be liable for damages for mistakes or delays in the transmission or delivery, or for the non-delivery, of any message, whether caused by the negligence of its servants or otherwise, beyond the sum of five thousand dollars, at which amount each message is deemed to be valued, unless a greater value is stated in writing by the sender thereof at the time the message is tendered for transmission, and unless the repeated-message rate is paid or agreed to be paid, and an additional charge equal to one-tenth of one percent of the amount by which such valuation shall exceed five thousand dollars.

3. This company is hereby made the agent of the sender, without liability, to forward this message over the lines of any other company when necessary to reach its destination.

4. Domestic messages and incoming cable messages will be delivered free within one-half mile of the company's office in towns of 5,000 population or less, and within one mile of such office in other cities or towns. Beyond these limits the company does not undertake to make delivery, but will, without liability, at the sender's request, as his agent and at his expense, endeavor to contract for him for such delivery at a reasonable price.

5. No responsibility attaches to this company concerning messages until the same are accepted at one of its transmitting offices; and if a message is sent to such office by one of the company's messengers, he acts for that purpose as the agent of the sender.

6. The company will not be liable for damages or statutory penalties in any case where the claim is not presented in writing within sixty days after the message is filed with the company for transmission.

7. It is agreed that in any action by the company to recover the tolls for any message or messages the prompt and correct transmission and delivery thereof shall be presumed, subject to rebuttal by competent evidence.

8. Special terms governing the transmission of messages according to their classes, as enumerated below, shall apply to messages in each of such respective classes in addition to all the foregoing terms.

9. No employee of the company is authorized to vary the foregoing.

THE WESTERN UNION TELEGRAPH COMPANY
INCORPORATED
R. B. WHITE, PRESIDENT

CLASSES OF SERVICE

TELEGRAMS

A full-rate expedited service.

NIGHT MESSAGES

Accepted up to 2:00 A.M. at reduced rates to be sent during the night and delivered not earlier than the morning of the ensuing business day.

Night Messages may at the option of the Telegraph Company be mailed at destination to the addressees, and the Company shall be deemed to have discharged its obligation in such cases with respect to delivery by mailing such night messages at destination, postage prepaid.

DAY LETTERS

A deferred day service at rates lower than the standard telegram rates as follows:

- Accepted up to 2:00 A.M. for delivery on the morning of the ensuing business day, at rates still lower than standard night message rates, as follows: The standard telegram rate for 10 words shall be charged for the transmission of 30 words or less, and one-fifth of such standard telegram rate for 10 words shall be charged for each additional 10 words or less.

- SPECIAL TERMS APPLYING TO DAY LETTERS:
  - A. Day Letters may be forwarded by the Telegraph Company as a deferred service and the transmission and delivery of such Day Letters is subject, subordinate to the priority of transmission and delivery of regular telegrams.
  - B. This Day Letter is received subject to the express understanding and agreement that the Company does not undertake that a Day Letter shall be delivered on the day of its date absolutely, and at all events; but that the Company's obligation in this respect is subject to the condition that there shall remain sufficient time for the transmission and delivery of such Day Letter on the day of its date during regular office hours, subject to the priority of the transmission of regular telegrams under the conditions named above.

NIGHT LETTERS

Accepted up to 2:00 A.M. for delivery on the morning of the ensuing business day, at rates still lower than standard night message rates, as follows:

- SPECIAL TERMS APPLYING TO NIGHT LETTERS:
  - A. Night Letters may at the option of the Telegraph Company be mailed at destination to the addressees, and the Company shall be deemed to have discharged its obligation in such cases with respect to delivery by mailing such Night Letters at destination, postage prepaid.

FULL RATE CABLES

An expedited service throughout. Code language permitted.

DEFERRED HALF-RATE CABLES

Half-rate messages are subject to being deferred in favor of full rate messages for not exceeding 24 hours. Must be written in plain language.

CABLE NIGHT LETTERS

An overnight service for plain language communications, at one-third the full rate, or less. Minimum of 25 words charged for. Subject to delivery at the convenience of the Company within 24 hours.

SHIP RADI OGRAMS

A service to and from ships at sea, in all parts of the world. Plain language or code language may be used.
SPECIFICATIONS FOR THE PUMP AND MOTOR FOR THE
FORT LEWIS SCHOOL, HESPERUS, COLORADO.

Bids are to be made f.o.b., Hesperus, Colorado.

Pump
Capacity 400 g.p.m. approximately, head 23 feet, total to be of moderate price, to have side suction and the discharge to be horizontally on the bottom, rotation to be clockwise.

Motor
Five horsepower, 1800 r.p.m., 3 phase, 440 volts equipped with base. The standard accessories shall consist of a safety switch and protected with 3 fuse- or equivalent (or equivalent)

The pump and motor are to be equipped with sheaves for V-belts. V-belts to be furnished. The pump is to be furnished with a suction elbow, sufficient pipe and a foot valve so that the vertical distance from the center line of the pump to the outside bottom of the strainer is four feet six inches. Pump dimensions are to be given for installation plans and also the distance between center lines of the pump and motor. It is desired to know if the pump case is tapped for a drain out at the low point.

Alternative Bid
If it is mechanically possible, it is desired to operate a pump at two speeds. This will involve attachment of 2 sheaves to the pump and motor so that the same set of belts can be used. At the high speed it is desired to pump about 450
Specifications for the Fort Lewis pump and motor -2-
g.p.m. against a head of 25 feet, and at the low speed about
350 g.p.m. against a head of 20 feet. If it is not mechanically
possible to make such a combination then the first plan is
to be followed.
May 8, 1935.

Byron Jackson Co.,
1515 12th Avenue,
Greeley, Colorado.

Attention: Mr. W. R. Paull.

Dear Mr. Paull:

I am enclosing a copy of "Specifications for the Pump and Motor for the Fort Lewis School, Hesperus, Colorado". As you will note the bids are to be made f.o.b., Hesperus.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

WEC:ls
enc.
Pipe Lines for Fort Lewis School
Items for Bidders.

Item
(1) Seep-stream line, six-inch pipe. Overall length
    1008.3 feet.
(2) 1 6" by 8" increaser with connection to spigot on
    8" T on existing 8-inch 14 gage welded steel pipe
    line furnished 1951 by Hardesty.
(3) 1 Riser 15 " long / To be fashioned for and fastened
(4) 1 Riser 18 " long / to 6½ Type B,K,T. alfalfa valves
(5) 2 Risers 12" long / furnished by the College. Length
    noted is from top of pipe.
(6) 2 6-inch Ts with blind caps.
(7) 1 5-inch T at pump, stem 2.0 feet long from center line
    of cross to end of flange, flange furnished by College.
    End of stem must be piece of pipe with standard threads.
    Flanges on cross to be peened on, the east flange to
    be left loose. See drawing.
(8) 2 5" by 6" increasers at T. See drawing.
(9) 2 5" iron gate valves non rising stem, flanged, new
(10) 2 5" " " " " " " "", second
    hand and reconditioned.
(11) 2 4" iron gate valves, non rising stem, flanged, new
(12) 2 4" " " " " " " "", second
    hand and reconditioned.
(13) 1 5-degree elbow at Sta. 0 + 55 West
(14) 1 20-degree elbow at Sta 0 + 90 West
(15) 1 piece of 2" by 4" channel iron of length to fit between
    valve flanges as shown on drawing with 2 13/16-inch
    holes 6 inches from center.

Items for south extension.
(16) 500 feet, approximately, of 6-inch pipe.
(17) 2-3 6-inch risers 12 inches long above top of pipe.
    to be attached to 6½ alfalfa valves.
3.2\^2 = 10.2
3.5\^2 = 12.25
\[\frac{12.25}{3.5' = 3.5'}\]

14.7\^2 = 216
30\^2 = 900
\[\frac{900}{11.6} = 77.6\]
\[\frac{14.7}{33.3} = 0.44\]

Lettter

To Pole

Profile - long station?

Riser: pulley size + face

To K.T.

Catalog

Quote of

4 = 6\(\frac{1}{2}\) type B alfalfa bales

2 = 8\(\frac{1}{2}\)
Job Specification

400 GPM
23 ft head
Clockwise rotation
Side suction, bottom drain dish
5 hp, 1800 rpm, 3 & 440 V with base

Pump must be equipped with

Flared end
Safety switch
3 fuses or equivalent

H + B
Wothington
A - C
A. C. Moir Co.

Hose, and sufficient pipes and fasteners with strainer so
that distance from top of drainage to bottom of strainer is 4' 6"
June 26, 1935

Mr. W. E. Code,
State Agricultural College,
Fort Collins, Colorado.

Dear Mr. Code:

We received your note asking us to substitute a 4" check valve for the 4" foot valve on pump ordered for the Fort Lewis School.

All the equipment has been shipped from Denver, including the foot valve, and we hesitate in sending the check valve, which is considerably higher in price, until we have your authority to do so.

Please let us know whether we should ship the check valve and have you return the foot valve, and oblige.

Yours very truly,
HENDRIE & BOLTHOFF MFG. & SUPPLY CO.

J.M.Rihn--BP
June 29, 1935

Hendrie and Bolthoff
1635 17th. St.
Denver, Colo.

Dear Mr. Rihn:

I was sorry to learn that I was too late in changing the order for the Ft. Lewis pump equipment. I have authority to ask you to ship a 4" check valve which is to be flanged, and drilled to fit the pump. Ship by the cheapest method. I shall notify Ft. Lewis to return the foot valve transportation paid to Denver. Ship check valve prepaid.

Yours very truly

W.F. Code
Associate Irrigation Engineer
August 13, 1935.

Dean E. H. Bader,
Fort Lewis School,
Hesperus, Colorado.

Dear Dean Bader:

I believe I understand now the difficulty you are having with the hydrants fitting the valves. It is evidently an error on the part of the Thompson Manufacturing Company to have attached the pipes to the outside of the valve flange. It did not occur to me that it was necessary to specify how these valves were to be attached.

Would it not be possible to either rivet or weld an angle iron around the pipe at an elevation so that the lugs from the hydrant could be properly attached. If an entire circle of angle iron could not be fastened, possibly short pieces would do the work as well. It is probable that the Thompson Company will come forth with a good idea also as to how the hydrants can be attached.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
W. E. Code  
Associate Irrigation Engineer  
Irrigation Investigations  
Fort Collins, Colorado  

Dear Mr. Code:  

In answer to yours of August 6th, I should like to state that the new valves are number 6½ type B. The trouble that we are having is not with the valve itself, but with the supporting arch around the valve. The old ones were attached directly to the six-inch pipe and had a projecting flange to which we could clamp the hydrant. The new flange supports are set inside of the pipe connection, which is enlarged to accommodate this fitting which leaves no flange for attachment of the hydrant. As we recall, the term "Q Arch" is used to describe the fitting which we needed.  

We have taken the matter up with Mr. Koonce of the Thompson Manufacturing Company, who is going to see what may be done. The boys are working on the installation now and we will soon have the pipe laid to the pump site, and we hope to have this in operation soon.

Very truly yours,

E. H. Bader, Dean
Irrigation Investigations  
Ft. Collins, Colo.

Attention: Mr. W. E. Code  
Associate Irrigation Engineer

Dear Mr. Code:

We are very sorry we neglected to give you complete information covering the pump on which we quoted in our letter of May 11. In this connection we are pleased to advise that a 5" Figure 3601 pump, operating at 1005 revolutions per minute against a 25' head and delivering 450 gallons per minute, will require 4.2 horse power or a pump efficiency of approximately 66%. The same pump operating at 925 revolutions per minute against a 20' head and delivering 350 gallons per minute, will require 3.15 horse power or a pump efficiency of 56%. The distance between the center line of the pump and center line of motor when operating with 5.2" p.d. motor sheave will be 18". The center distance when operating with 5.8 p.d. motor sheave will be 18 ½". You will note that the change in center distance due to the change in sheave diameter is only one-half inch. This can be readily taken care of in the sliding base of the motor as the maximum allowable travel of the motor on the sliding base is 4".

In regard to your use of a safety switch equipped with fusetrons, we wish to advise that the price would be the same as the WK-16 starter. We would recommend use of the starter as it is a much more compact unit and no fuse replacements are necessary, the overload protection being taken care of by bi-metallic strips.

In regard to the one pulley pump installation to handle 400 gallons per minute against a total head of 23', we are pleased to quote on the following:

1 - 5" Figure 3601 Standard Fitted Belt-driven Goulds Centrifugal Pump to operate at 924 r.p.m. with a power requirement of 3.4 horse power and an efficiency of 68.5%.

Price F.O.B. Denver with freight allowed to Hesperus, Colo. $131.55
1 - 5.2" Pitch Diameter Sheave with two grooves for "B" section Belts.

1 - 10" ditto

2 - #60-B Belts

Price for the lot, F.O.B. Denver, Colorado with freight allowed to Hesperus, Colo. ............... $19.00

1 - 5 h.p. 1750 r.p.m. 3 phase, 60 cycle, 440 volt, sleeve bearing General Purpose Westinghouse Squirrel Cage Induction Motor with base and WK-16 linestarter with overload and undervoltage protection, but without pulley.

Price F.O.B. Hesperus, Colorado ...................... $95.00

We hope this will give you the information that you require, and we are looking forward to the receipt of your order.

Yours very truly,

THE MINE AND SMELTER SUPPLY CO.

C.A. Buchen: jm
May 13, 1933.

Mine & Smelter Supply Co.,
1422 Seventeenth Street,
Denver, Colorado.

Attention: C. A. Buchen.

Dear Mr. Buchen:

Your letter of the 11th submitting a bid for a pump for the Fort Lewis School has just been received.

One of the things omitted in this bid was the efficiency characteristics of the proposed pump. Would you supply these characteristics for the recommended speeds? May I also inquire if changing the motor pulley from 5.2 inches to 5.3 inches that no foundation change will be necessary for the motor, in other words, will the rails for the motor take up the difference in sheave diameters. We will also like a quotation on a 1-pulley installation pumping 400 g.p.m., also would you be so kind as to state approximately the distance between pulley centers for the proposed V-belts.

In your quotation on the motor would there be any saving in omitting the WK-16 line starter using instead a safety switch equipped with fuseholders.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

WEC:1s
Irrigation Investigations
Fort Collins, Colorado

Attention Mr. W. E. Code,
Associate Irrigation Engineer

Gentlemen:

In accordance with your inquiry addressed to our Mr. Evans, we are pleased to quote you on suitable pump with driving equipment and suction pipe to handle 450 gallons per minute of clear cold water against a net total head of 25 feet at 1005 revolutions per minute, or 350 gallons per minute of clear cold water against a net total head of 20 feet at 925 RPM.

As stated above, this pump is suitable for either capacity by merely changing the speed of the pump. This change in speed can be obtained by changing the sheave on the motor shaft, and for that reason we are quoting two sheaves for the motor. The equipment proposed is as follows:

1 - 5" Figure 3601, Standard Fitted, Belt Driven Goulds Centrifugal Pump with 9-7/8" diameter impeller without pulley.
   Price F.O.B. Denver, Colo. with freight allowed to Hesperus, Colo. - - - - - - - - - - - - - - - - - - - - - $131.55

1 - 5.2" Pitch Diameter Sheave with two grooves for "B" section Belts.
1 - 5.8"
1 - 10"
2 - #60-B Belts
   Price for the lot F.O.B. Denver, Colorado with freight allowed to Hesperus, Colo. - - - - - - - - - - - - - - - - - - - - - 23.40

1 - 5 H.P., 1750 RPM, 3 phase, 60 cycle, 440 volt, sleeve bearing General Purpose Westinghouse Squirrel Cage Induction Motor with base and WK-16 linestarter, with overload and undervoltage protection, but without pulley.
   Price F.O.B. Hesperus, Colo. - - - - - - - - - - - - - - - - - - - - - 95.00
THE MINE AND SMELTER SUPPLY CO.

To Irrigation Investigations
Fort Collins, Colorado

Date May 11, 1935
Our File M-2399

1 - 5" Flanged Elbow
1 piece - 5" Standard Wrought Pipe 3'-3" long
1 - Clearflow Foot Valve

Price for the lot F.O.B. Denver, Colo. with
freight allowed to Hesperus, Colo. --- --- --- $55.40

We are sure that the above equipment will give you a very inexpensive
but efficient installation.

We thank you for your inquiry and are looking forward to the opportunity
of serving you in this connection.

Yours very truly,

THE MINE AND SMELTER SUPPLY COMAPNY

C. A. Buchen

C. A. Buchen: AER
May 28th, 1935

Mr. W.E. Code,
Associate Irrigation Engineer,
Fort Collins, Colorado.

Dear Sir;

We have your letter of May 25th in regard to 4" pump for the Fort Lewis School, and regret to note that you will not be able to use either our Type "SSU" or Type "S" pump.

In regard to price, our Type "S" prices on these small pumps are especially favorable and we wonder if you can get a cheaper pump which will do the work, which would require using a 5 HP motor. In regard to the "SSU" unit, the greater part of the price is in the motor.

In case you decide to purchase a cheaper pump we would at least like to offer the motor and the Texrope Drive. If you will let us have the maximum and minimum RPM of the pump, we shall be pleased to quote you on the motor and texrope drive, and we will also be pleased to request our factory to quote us on sheaves of variable pitch diameter to cover the two conditions.

Hoping to hear from you, we are,

Very truly yours,

ALLIS CHALMERS MFG. COMPANY

Manager Denver Office.
June 6, 1935.

Mine & Smelter Supply Co.,
1422 Seventeenth St.,
Denver, Colorado.

Attention: Mr. C. A. Buchen.

Dear Mr. Buchen:

Replying to your letter of the fifth, may I express our appreciation and thanks for submitting a bid on the pumping equipment for the Fort Lewis School at Hesperus. Final consideration of this pump has just been made, and it was decided that a Deming pump be purchased from the Hendrie Bolthoff Company. Their pump seemed to be very efficient over the range of conditions we anticipate, and the price is in line with the qualities which we had planned for this job.

Thanking you again, I am

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

WEG:ls
Irrigation Investigations
Ft. Collins, Colorado

Attention: Mr. W. E. Code
Associate Irrigation Engineer

Dear Mr. Code:

On May 11th and May 17th we had the pleasure of quoting you on pumping equipment for the Ft. Lewis School at Hesperus, Colorado. To date we have heard nothing further from you regarding this equipment. We are wondering whether the information given you at that time was sufficient and whether you are still considering the purchase of this equipment.

We would greatly appreciate a line from you as to whether or not we may expect to hear further, or your communication in the event that you desire any additional information.

Yours very truly,

THE MINE AND SMELTER SUPPLY CO.

C.A. Buchen

Our File M-2399
June 6, 1935.

Worthington Pump & Machinery Corp.,
1708 Welton St.,
Denver, Colorado.

Attention: Mr. Paul E. Wilson

Dear Mr. Wilson:

I wish to thank you for your kindness in submitting a bid on the pumping equipment for the Fort Lewis School near Hesperus. Final consideration on this equipment has been recently made, and I wish to inform you that a Deming pump is to be ordered from the Hendrie Bolthoff Company for this job. This is a lighter and cheaper pump than you have bid on but seems to fit the conditions we anticipate.

Thanking you again, I am

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
May 13, 1935.

Worthington Pump & Machinery Corp.,
1706 Welton St.,
Denver, Colorado.

Gentlemen:

On April 30 an invitation was extended you to bid on a pump for the Fort Lewis School near Hesperus, Colorado.

In order not to delay the selection of this pump would you please advise me if you do not intend to bid on the items given in the letter of that date.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
Irrigation Investigations  
Fort Collins, Colorado

Gentlemen:

Referring to your letter of April 30 and subsequent letter of May 13 regarding quotation on pumping plant for Fort Lewis School near Hesperus, Colorado. We are sorry that we did not get this information to you sooner, but we have been endeavoring to work out what would be the best arrangement and the most ideal set up for this particular condition.

After considering your problem carefully from all angles, it appears to us that a unit belt driven by a 5 HP motor designed for 400 GPM against a 23' head and arranged to operate at a single speed will be the most suitable. For the lower capacity you could throttle this unit and as the power involved is small, the loss would be very small. For these conditions, we offer the following unit:

One (1) WORTHINGTON 4-F-1 Volute Centrifugal Pump arranged for belt drive as described in specifications sheet attached. Unit to be fitted complete with suction elbow and provided with V-Belt drive for operating it at 1150 RPM when driven by 1750 RPM motor.

One (1) 5 HP, 1750 RPM, 3 phase, 60 cycle, 440 volt motor complete with base.

Shipping weight of complete unit approximately......600#
Price your lowest net.........................$350.
with full freight allowed to Hesperus, Colorado.

If it were desired, this pump could be designed to operate at 450 GPM against 25' TDH and then when it was desirable to operate at 350 GPM at 20' Total head, the speed could be changed to 900 RPM by changing the sheaves on the pump or motor or both, the same belts being satisfactory for operation. Such a drive as this, that is, the sheaves for making the change would cost approximately $15.00 additional.
We would not recommend that both the large and small sheave be mounted on the same shaft as it gives too much overhang for satisfactory operation. If, however, it is found desirable to change the speed there would be no reason for not purchasing the pump with the extra sheave for making such change.

We have not quoted on starting equipment for this motor as we are not certain of the type required.

Neither have we quoted on suction pipe in foot valve as we do not manufacture such equipment and, consequently, the School will be able to purchase at the same price as we would and in order to get the lowest price proposition it would be better for you to obtain this price from some local manufacturer.

We trust that this will give you the information that you desire in regard to this matter and that we may be of service to you in supplying this unit.

Very truly yours,
WORTHINGTON PUMP & MACHINERY CORPORATION

[Signature]
Paul E. Wilson
Denver District Sales

PEW/RW
WORTHINGTON CENTRIFUGAL PUMPS
SINGLE-STAGE VOLUTE
TYPE F

BUILT TO ONE QUALITY STANDARD ONLY . . . THE HIGHEST

WORTHINGTON
THESE pumps, with non-clogging impellers of special design, rugged casings, large diameter shafts, comparatively low velocities, have been perfected to give continuous, uninterrupted operation, even under the most severe service.

They are designed for pumping unscreened sewage, sludge, slaughterhouse refuse, and other liquids containing solid matter in suspension.

Worthington offers these perfected pumps in a number of pattern sizes covering capacities from 85 to 7,500 gallons per minute, each size selected to give the maximum performance for the power involved.
The above curve shows graphically the application of a number of pumps to a system with variable present requirements and a future requirement. Pump A is selected for the minimum capacity condition and pump B for the normal condition, the two being used in parallel for the maximum condition. For the future conditions two additional pumps are installed, one a duplicate of A and the other a duplicate of B. Paralleling these gives a total of eight capacities possible with constant-speed motors and without throttling. Inasmuch as the pumps are always selected to work near their best efficiency point and to load up their driving motor, this method of operation involves the minimum power loss and shows great economy.
### Dimensions

All dimensions are in inches. Dimensions not to be used for construction purposes.

#### Optional Positions of Discharge

<table>
<thead>
<tr>
<th>SIZE AND TYPE</th>
<th>DISCHARGE DIAM.</th>
<th>SUCTION DIAM.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-F-1</td>
<td>3</td>
<td>4</td>
<td>33 1/2</td>
<td>22 1/2</td>
<td>11 1/2</td>
<td>5 1/2</td>
<td>3/8</td>
<td>8 1/2</td>
<td>8</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>3-F-2</td>
<td>3</td>
<td>4</td>
<td>33 1/2</td>
<td>22 1/2</td>
<td>11 1/2</td>
<td>5 1/2</td>
<td>3/8</td>
<td>8 1/2</td>
<td>8</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>3-F-3</td>
<td>4</td>
<td>4</td>
<td>36 1/2</td>
<td>25 1/2</td>
<td>11 1/2</td>
<td>5 1/2</td>
<td>3/8</td>
<td>9 1/2</td>
<td>9 1/2</td>
<td>11</td>
<td>8 1/2</td>
</tr>
<tr>
<td>4-F-1</td>
<td>4</td>
<td>5</td>
<td>34</td>
<td>22 1/2</td>
<td>11 1/2</td>
<td>5 1/2</td>
<td>3/8</td>
<td>9 1/2</td>
<td>8 1/2</td>
<td>12</td>
<td>7 1/2</td>
</tr>
<tr>
<td>4-F-2</td>
<td>4</td>
<td>5</td>
<td>37</td>
<td>25 1/2</td>
<td>11 1/2</td>
<td>5 1/2</td>
<td>3/8</td>
<td>10 1/2</td>
<td>10 1/2</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>5-F-1</td>
<td>5</td>
<td>6</td>
<td>37 1/2</td>
<td>36</td>
<td>26</td>
<td>11 1/2</td>
<td>3/8</td>
<td>11 1/2</td>
<td>11 1/2</td>
<td>13</td>
<td>9 3/4</td>
</tr>
<tr>
<td>5-F-2</td>
<td>5</td>
<td>6</td>
<td>46</td>
<td>33 1/2</td>
<td>12 1/2</td>
<td>9 1/2</td>
<td>3/8</td>
<td>13 1/2</td>
<td>12 1/2</td>
<td>13</td>
<td>10 1/2</td>
</tr>
<tr>
<td>6-F-1</td>
<td>6</td>
<td>8</td>
<td>47 1/2</td>
<td>33 1/2</td>
<td>13 1/2</td>
<td>14 1/2</td>
<td>13 1/2</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-F-2</td>
<td>8</td>
<td>10</td>
<td>47 1/2</td>
<td>33 1/2</td>
<td>13 1/2</td>
<td>14 1/2</td>
<td>13 1/2</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-F-1</td>
<td>10</td>
<td>10</td>
<td>48 1/2</td>
<td>34 1/2</td>
<td>14 1/2</td>
<td>15 1/2</td>
<td>14 1/2</td>
<td>24</td>
<td>12 3/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-FA-2</td>
<td>12</td>
<td>12</td>
<td>61 1/2</td>
<td>43 1/2</td>
<td>18</td>
<td>13 1/2</td>
<td>11 1/2</td>
<td>21</td>
<td>20 1/2</td>
<td>27</td>
<td>17 1/2</td>
</tr>
</tbody>
</table>

*10-FA-2 has foot support under casing.

### Maximum and Minimum Capacity, Head and Speed

<table>
<thead>
<tr>
<th>SIZE AND TYPE</th>
<th>MAXIMUM CAPACITY</th>
<th>MINIMUM CAPACITY</th>
<th>MAXIMUM HEAD</th>
<th>MINIMUM HEAD</th>
<th>MAXIMUM SPEED</th>
<th>MINIMUM SPEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-F-1</td>
<td>540</td>
<td>85</td>
<td>72</td>
<td>12</td>
<td>1800</td>
<td>1200</td>
</tr>
<tr>
<td>3-F-2</td>
<td>615</td>
<td>100</td>
<td>78</td>
<td>9</td>
<td>1800</td>
<td>900</td>
</tr>
<tr>
<td>3-F-3</td>
<td>575</td>
<td>150</td>
<td>138</td>
<td>14</td>
<td>1800</td>
<td>900</td>
</tr>
<tr>
<td>4-F-1</td>
<td>750</td>
<td>175</td>
<td>78</td>
<td>18</td>
<td>1800</td>
<td>1200</td>
</tr>
<tr>
<td>4-F-2</td>
<td>1180</td>
<td>180</td>
<td>125</td>
<td>14</td>
<td>1800</td>
<td>900</td>
</tr>
<tr>
<td>5-F-2</td>
<td>1800</td>
<td>250</td>
<td>130</td>
<td>13</td>
<td>1800</td>
<td>900</td>
</tr>
<tr>
<td>5-F-3</td>
<td>2200</td>
<td>350</td>
<td>105</td>
<td>16</td>
<td>1200</td>
<td>900</td>
</tr>
<tr>
<td>6-F-1</td>
<td>2500</td>
<td>400</td>
<td>100</td>
<td>10</td>
<td>1200</td>
<td>720</td>
</tr>
<tr>
<td>6-F-2</td>
<td>2800</td>
<td>400</td>
<td>118</td>
<td>21</td>
<td>1200</td>
<td>720</td>
</tr>
<tr>
<td>10-F-1</td>
<td>3300</td>
<td>1100</td>
<td>47</td>
<td>14</td>
<td>900</td>
<td>720</td>
</tr>
<tr>
<td>10-FA-2</td>
<td>7500</td>
<td>1500</td>
<td>94</td>
<td>22</td>
<td>900</td>
<td>720</td>
</tr>
</tbody>
</table>

---

**WORTHINGTON PUMP AND MACHINERY CORPORATION**

Works: Buffalo, N.Y. Harrison, N.J. Newark, N.J.

General Offices: Harrison, New Jersey

District Sales Offices and Representatives:

Branch Offices or Representatives in Principal Cities of Foreign Countries

Printed in U.S.A. Copyright 1934 by Worthington Pump and Machinery Corporation
May 25, 1935.

Allis Chalmers Manufacturing Co.,
Continental Oil Building,
Denver, Colorado.

Attention: Mr. W. R. Judson.

Dear Mr. Judson:

Pardon my delay in answering your recent correspondence regarding a 4-inch pump for the Fort Lewis School.

Although we have not yet decided on the pump, I feel that your type SSU is not the one desired since we wish to have a free 5-horsepower motor for other uses. Your type S pump will not be in line with other quotations which we are asking for because yours is a higher quality pump.

Thank you for your time and consideration which you have extended us.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
April 22, 1935.

Allis Chalmers Manufacturing Co.,
Continental Oil Building,
Denver, Colorado.

Attention: Mr. J. L. Singleton.

Dear Sir:

Sometime ago through your kindness I received some of your literature on the type "SSU" pumping units, and in the accompanying letter of March 7 you speak of the larger units which are now available.

I am interested in getting information on the possibility of pumping about 400 g.p.m. against a head of about 18 feet, and think that it might be possible to do so with a 3 horsepower motor. I do not have all the information at hand as to head, but the capacity could be revised somewhat in order to come under the 3 horsepower rating. I wondered if one of these units might fit. If not, do you have any other medium cost pump, probably side suction, that would do this work. In order to obtain favorable characteristics, we would be willing to drive such a pump with V-belts. This pump would be used at Fort Lewis near Durango for pumping seep stream water.

May I have your expert opinion as to how to connect the discharge from a side suction pump to a discharge line which lies below it. If the discharge nozzle is on top and pointed horizontally, is this not the best position for throwing out air. If the discharge nozzle is pointed horizontally and on the bottom would there any difficulty in air locking. It might be possible in the second case to connect to the transverse pipe line with the straight T. If the discharge nozzle was on top it would be necessary to have an elbow between the pump and the T. In order to get my point better, I am making a sketch showing the condition.
I shall greatly appreciate any information which will allow me to make specifications for the purchase of a pump at that school.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
Prof. W.E. Code,
Asso. Irrigation Engr.,
Colorado Experiment Station,
US Department of Agriculture,
Fort Collins, Colorado.

Dear Sir:-

We have your letter of April 22nd addressed for attention of Mr. Singleton in regard to an "SSU" pumping unit for a capacity of 400 gallons per minute against 18 ft. head with 3 HP motor for Fort Lewis, near Durango.

Mr. Singleton is out of town, and we understood that he planned to call on you at Fort Collins yesterday, in which case he will have gone into this matter with you.

However, in case he has not, we can probably furnish you with a pump of the required capacity and head in our 4 x 3 Type "SSU-N" pump at 1750 RPM. This pump would throw about 440 gallons per minute against 18 ft head but would require a 5 HP motor. This point is just beyond the end of the characteristic curve, and it may be that the capacity would not be quite so high. This horsepower is greater than you desire to use, and it may be that we can offer a pump of this size with 3 HP with 1160 RPM motor, which would be better adapted to your conditions, and we are taking the matter up with our factory in order to see what we can offer.

In regard to connection of this pump to your horizontal discharge main pipe to the pump shaft, we would prefer the second alternative with the discharge nozzle horizontal and on the bottom. It would be necessary to look out for entrapped air; in this connection we would like to know whether your discharge line is entirely horizontal, that is, if there is any real discharge head on the pump. Please advise us the amount of suction lift and discharge lift measured vertically. The altitude will have an important bearing on the suction lift, and we are advising the factory that the pump will operate at an elevation of about 6500 feet, and we are asking what will be the maximum suction lift possible.
Prof. W.E. Code, -2- 4-24-35

You have not given us the current characteristics, and we are assuming that this will be three phase, 60 cycle, 440 volts, otherwise, please advise.

We shall write you again as soon as we hear from the factory, and in the meantime we thank you for your inquiry.

very truly yours,

ALLIS CHALMERS MFG. COMPANY

WRJ W
MANAGER DENVER OFFICE.
Mr. W.E. Code,
Assoc. Irrigation Engr.,
Colorado Experiment Station,
US Department of Agriculture,
Fort Collins, Colorado.

Dear Mr. Code:

We have your letter of the 30th ult. in regard to a centrifugal pump for Fort Lewis School for delivering 300 to 450 gallons per minute through 850 feet of 6" pipe with a vertical lift of 7.5 feet plus 3 feet suction, and alterly through 125 feet of 6" pipe with a vertical lift of 19 ft. plus 3 ft. suction.

We have made a tabulation of the total heads to be encountered under the various conditions, as follows:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallons Per Minute</td>
<td>450</td>
<td>350</td>
<td>450</td>
<td>350</td>
</tr>
<tr>
<td>Pipe line</td>
<td>850' x 6&quot;</td>
<td>850' x 6&quot;</td>
<td>125' x 6&quot;</td>
<td>125' x 6&quot;</td>
</tr>
<tr>
<td>Pipe friction ft. head</td>
<td>22.6</td>
<td>14.9</td>
<td>3.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Friction in valve, elbow and tee - ft.</td>
<td>1.0</td>
<td>0.7</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Vertical discharge lift - ft.</td>
<td>7.5</td>
<td>7.5</td>
<td>19.0</td>
<td>19.0</td>
</tr>
<tr>
<td>Vertical suction lift - feet</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Total dynamic lift - feet</td>
<td>34.1</td>
<td>26.1</td>
<td>26.3</td>
<td>24.9</td>
</tr>
<tr>
<td>Theoretical HP</td>
<td>3.83</td>
<td>2.31</td>
<td>2.98</td>
<td>2.21</td>
</tr>
</tbody>
</table>

You will note that for 450 gallons through 850 ft. of pipe we get a total approximate head of 34.1, and for the other conditions from 24.9 to 26.3 ft. We understand that the 3 ft suction lift is in addition to the 19 and 7.5 ft. vertical lift in the discharge pipe.

We do not make a side suction pump except in our Type "SSU" and for this service would offer our regular Type "S" pump, as shown in the Leaflet herewith. We can arrange this.
pump with two sets of grooved pulleys for running at approximately 1800 and 1500 RPM, in order to accommodate the various conditions but in order to find the exact speeds, will be obliged to refer this matter to Milwaukee.

Will you please check over the heads given in the above table and let us know if they are in accordance with your calculations as they seem to be somewhat different from the total heads of 20 and 25 feet given in your specification.

It seems to us that a simpler arrangement would be to use one of our direct connected units, as shown in the leaflet, with the motor coupled to the pump and running at 1740 RPM. Control of the quantity of water discharged at the beginning and end of the pumping season and in the two different pipe lines would be controlled by the gate valves in the discharge. The pump which we are offering for this service would have an efficiency of between 70 and 80 percent under all of these conditions, and we do not believe you could improve on this very much by running the pump at lower speed for the lower head. We could arrange the pump, either with an extended shaft at the end opposite the coupling for taking a standard flat pulley, which would probably be somewhat more convenient than removing the half coupling and put on a pulley.

The price of this 4 x 4" pump with 5 HP, 1740 RPM sleeve bearing motor, squirrel cage type, 3 phase, 60 cycle, 440 volt and with primary manually operated switch with thermal protection, would be ... $263.01 f.o.b. Milwaukee, with freight allowed to your nearest railway station.

Additional price for base for this would be ... $5.04

This does not include the extra charge for extension shaft and standard belt pulley 4½ x 4" - this would be ... ......... ................................. $10.92

Shipment of this unit could be made in from 2 to 3 weeks after receipt of necessary information at Milwaukee.

In case you do not approve of our recommendations for the direct connected pump, please advise us so that we can write to our factory on the basis of the head given in our above tabulation, and we shall then be pleased to get definite recommendations from Milwaukee. However, the direct connected pump will be cheaper and easier to operate than the dual V-belt drive.

Thanking you for your advices, we are,

Very truly yours,

W.R. Shephard
Manager Denver Office.

W.E. Code
Fort Collins, Colo

RE Pump for Ft. Lewis
Type "S" Centrifugal Pumps

The Type "S" centrifugal pump is a double suction single stage pump designed for a wide variety of uses. The efficiencies of these pumps are high resulting in savings in power consumption.

These pumps can be furnished bronze fitted, cast iron fitted or with the casing solid bronze depending upon the liquid to be handled. Special features are often provided to meet unusual conditions.

Allis-Chalmers centrifugal pumps are subject to rigid shop tests before being shipped to the purchaser and permanent records of these tests are kept for future reference.
Section thru 3\"x1\$/2\" S-N, 3\"x1\$/2\" S-NH, 3\"x2\$/2\" S-K, 4\"x2\" S-L, 4\"x2\" S-LH, 4\"x2\$/2\" S-K, 4\"x2\$/2\" S-KH, 4\"x3\" S-H, 4\"x3\" S-HH, 4\"x3\" S-K, 4\"x4\" S-H, 5\"x4\" S-HH, 5\"x4\" S-J, 5\"x4\" S-K, 5\"x4\" S-KH, 5\"x5\" S-G, 6\"x3\" S-J, 6\"x3\" S-JH, 6\"x5\" S-G, 6\"x5\" S-GH, 6\"x5\" S-H, 6\"x6\" S-F, 8\"x4\" S-F, 8\"x6\" S-F, 8\"x6\" S-J, 8\"x8\" S-F, 8\"x8\" S-FH, 8\"x8\" S-J, 8\"x8\" S-JH, 10\"x8\" S-H, 10\"x10\" S-F, 12\"x10\" S-H, 10\"x10\" S-J, 12\"x12\" S-E, 16\"x14\" S-E, 16\"x14\" S-F, 20\"x18\" S-H. (8\"x4\" S-F, 12\"x10\" S-H, 12\"x10\" S-J, 14\"x12\" S-H, 16\"x16\" S-F and 20\"x18\" S-H pumps have bearing brackets bolted on casing.)

(3\"x1\$/2\" S-NH, 4\"x2\" S-LH and 4\"x2\$/2\" S-KH pumps have ball bearings on outboard end instead of sleeve bearings.)

(4\"x3\" S-G, 4\"x3\" S-GH, 4\"x4\" S-F and 4\"x4\" S-FH pumps have also runner wearing rings.)
How the Type “S” Pump is Constructed

1—CASING. The Casing is of cast iron, horizontally split with the suction and discharge nozzles located in the lower half of the Casing, permitting the interior to be easily inspected.

2—RUNNER. The Runner is made of bronze of the double suction enclosed type and is carefully balanced. The water passages are hand finished to a smooth surface.

3 & 4—WEARING RINGS. Bronze “L” shaped Casing Wearing Rings (3) held in place by tongue and groove are furnished with all Pumps. The Runner has a close running fit at these Rings to minimize the leakage of water back into the suction. Bronze Companion Wearing Rings (4) are furnished on the larger pumps. These Wearing Rings are easily renewable to allow replacement when worn.

7—SHAFT. The Shaft is made of heat treated steel of ample size to transmit the maximum power required.

8—STUFFING BOX BUSHINGS. Bronze Stuffing Box Bushings are provided where the shaft passes through the casing, protecting it from wear at this point.

9—SHAFT SLEEVES. The Shaft Sleeves are made from bronze castings and on the larger sizes are also provided with small grooves which throw off ordinary leakage from the gland. These sleeves seal at the runner hub.

12—PACKING. Soft, well lubricated Packing is furnished to reduce stuffing box resistance to the minimum and to prevent excessive wear on the shaft sleeves.

13—WATERSEAL RINGS. These Rings are of the bronze split type.

14—GLANDS. The Glands are split and made of bronze. A drip pocket is provided at the bottom of each Gland to take care of gland water leakage.

15—SHAFT SLEEVE NUTS. These Nuts are made of bronze or steel and not only hold the Shaft Sleeves and Runner in place but serve as an oil thrower inside of Bearing and water thrower outside of Bearing. On the smaller pumps (cut 20972) where the nut also takes care of the unbalanced thrust the material used is steel.

16—OIL HOLE COVERS. These Covers are provided with Spring lids which close tightly when released.

17—BEARING SHELL. The Radial Bearing on the larger Pumps is of the split type made of babbitt or of cast iron babbitt lined.

18—BEARING CAPS. The Bearing Caps fit tightly on the bearing housings. These housings in most instances are cast integral with the casing, assuring true alignment of the rotating element.

20—BEARING BUSHINGS. On the smaller pumps the Bearing Bushings are of the solid type cast of high grade babbitt.

21—THRUST BEARING. On the outboard end of the larger pumps a Center Collar Thrust Bearing is used. This takes care of any unbalanced thrust and avoids the throwing of oil.

22—THRUST SLEEVE. This Sleeve is keyed on to the Shaft and has two parallel faces which fit into the Thrust Bearing (21).

27—RETAINING NUT. This Nut is placed on the Shafts of the larger pumps to maintain the position of the Thrust Sleeve (22).

29—OILING RINGS. Bronze Oiling Rings are provided. Double Oiling Rings are used on most of the Pumps. Oil circulation is from surface of oil well to ends of bearing where it flows to center of bearing and is then quickly drained through hole in shell and hole in the supporting casting, taking it to bottom of oil reservoir, thereby insuring circulation of all oil in the reservoir.

31—COUPLINGS. Pin and Rubber Bushing Type Couplings connect the pump and drive.
Specify rotation when entering order.

| Size of Pump | A1 | B | C | D | E | F1 | H | I | K | L | M | N | O | P |
|--------------|----|---|---|---|---|----|---|---|---|---|---|---|---|---|---|
| *(a) 2" x 1/2" S-L | 174 | 94½ | 5½ | 5½ | 4 | 8½ | 6½ | 7 | 4½ |  |  |  |  |  |  |
| *(b) 2½" x 2" S-J | 214 | 11½ | 3½ | 6½ | 4½ | 9½ | 7 | 7 | 5½ |  |  |  |  |  |  |
| *(c) 2½" x 2½" S-H | 234 | 94½ | 3½ | 5½ | 3½ | 9½ | 7 | 7 | 5½ |  |  |  |  |  |  |
| *(d) 3" x 2½" S-N | 214 | 11½ | 4½ | 7½ | 6 | 13½ | 8½ | 7½ | 6½ |  |  |  |  |  |  |
| *(e) 3½" x 3½" S-K | 274 | 15½ | 6½ | 8½ | 9½ | 13½ | 11 | 10½ | 9½ |  |  |  |  |  |  |
| *(f) 4" x 3½" S-I | 344 | 17½ | 8½ | 11½ | 11½ | 15½ | 13½ | 12½ | 11½ |  |  |  |  |  |  |
| *(g) 42" S-L | 304 | 15 | 7½ | 9½ | 7½ | 12½ | 9½ | 8½ | 7½ |  |  |  |  |  |  |
| *(h) 42½" S-K | 374 | 19½ | 9½ | 12½ | 12½ | 16½ | 14½ | 13½ | 12½ |  |  |  |  |  |  |
| *(i) 4" x 3½" S-H | 274 | 15½ | 7½ | 9½ | 9½ | 13½ | 11 | 10½ | 9½ |  |  |  |  |  |  |
| *(j) 4" x 4" S-H | 314 | 18½ | 9½ | 12½ | 12½ | 16½ | 14½ | 13½ | 12½ |  |  |  |  |  |  |
| *(k) 4" x 4½" S-F | 314 | 18½ | 6½ | 8½ | 8½ | 13½ | 11 | 10½ | 9½ |  |  |  |  |  |  |
| *(l) 4" x 4½" S-P | 334 | 20½ | 6½ | 8½ | 8½ | 13½ | 11 | 10½ | 9½ |  |  |  |  |  |  |
| *(m) 5" x 4" S-H | 364 | 21½ | 6½ | 8½ | 8½ | 13½ | 11 | 10½ | 9½ |  |  |  |  |  |  |
| *(n) 5" x 4½" S-F | 364 | 21½ | 6½ | 8½ | 8½ | 13½ | 11 | 10½ | 9½ |  |  |  |  |  |  |
| *(o) 6" x 5" J | 33 | 18½ | 5½ | 7½ | 6½ | 11½ | 9½ | 8½ | 7½ |  |  |  |  |  |  |
| *(p) 6" x 5" S-G | 33 | 18½ | 4½ | 6½ | 6½ | 11½ | 9½ | 8½ | 7½ |  |  |  |  |  |  |
| *(q) 6" x 5" J | 33 | 18½ | 4½ | 6½ | 6½ | 11½ | 9½ | 8½ | 7½ |  |  |  |  |  |  |
| *(r) 6" x 5" S-F | 33 | 18½ | 4½ | 6½ | 6½ | 11½ | 9½ | 8½ | 7½ |  |  |  |  |  |  |
| *(s) 8" x 6" S-H | 414 | 22½ | 8½ | 11½ | 11½ | 16½ | 14½ | 13½ | 12½ |  |  |  |  |  |  |
| *(t) 8" x 6" S-P | 414 | 22½ | 8½ | 11½ | 11½ | 16½ | 14½ | 13½ | 12½ |  |  |  |  |  |  |
| *(u) 8" x 6½" S-H | 414 | 22½ | 8½ | 11½ | 11½ | 16½ | 14½ | 13½ | 12½ |  |  |  |  |  |  |
| *(v) 8" x 6½" S-P | 414 | 22½ | 8½ | 11½ | 11½ | 16½ | 14½ | 13½ | 12½ |  |  |  |  |  |  |
| *(w) 10" x 8" S-H | 454 | 25½ | 10½ | 13½ | 13½ | 19½ | 17½ | 16½ | 15½ |  |  |  |  |  |  |
| *(x) 10" x 8" S-P | 454 | 25½ | 10½ | 13½ | 13½ | 19½ | 17½ | 16½ | 15½ |  |  |  |  |  |  |
| *(y) 10" x 10" S-H | 454 | 25½ | 10½ | 13½ | 13½ | 19½ | 17½ | 16½ | 15½ |  |  |  |  |  |  |
| *(z) 10" x 10" S-P | 454 | 25½ | 10½ | 13½ | 13½ | 19½ | 17½ | 16½ | 15½ |  |  |  |  |  |  |

(a) These dimensions also apply for 2½" x 1/2" S-LH.
(b) These dimensions also apply for 2½" x 1/2" S-HH.
(c) These dimensions also apply for 2½" x 2½" S-HH.
(d) These dimensions also apply for 3½" x 3½" S-HH.
(e) These dimensions also apply for 3½" x 3½" S-HH.
(f) These dimensions also apply for 3½" x 3½" S-HH.
(g) These dimensions also apply for 3½" x 3½" S-HH.
(h) These dimensions also apply for 3½" x 3½" S-HH.
(i) These dimensions also apply for 4" x 4½" S-LH.
(j) These dimensions also apply for 4" x 4½" S-LH.
(k) These dimensions also apply for 4" x 4½" S-LH.
(l) These dimensions also apply for 4" x 4½" S-LH.
(m) These dimensions also apply for 4" x 4½" S-LH.
(n) These dimensions also apply for 4" x 4½" S-LH.
(o) These dimensions also apply for 6" x 3½" S-LH.

Dimension "L" is the overall dimension of any drive selected. Dimension "M" is the distance from centerline to feet (or lowest part) of drive. Dimension "N" is the width of the base plate. The minimum width of the base plate is ordinarily a few inches in excess of "H" plus "L." Dimension "O" is the length of base plate. This is ordinarily somewhat shorter than "A" plus "L." Dimension "P" is dimension "D" or dimensions "M," whichever is greater plus the height of the base plate which is approximately as follows:

Pumps to 4½ x 4½ size — 3" 
5½ x 4½ to 8¾ x 8½ size — 4" 
10½ x 10½ to 16 x 16 size — 6" 
Above 16 x 16 size — 9"

Rotation can be made either clockwise or counterclockwise when looking at pump from coupling end.

Specify rotation when entering order.

*When these pumps are furnished for direct connection to electric motors base plates with drip lips will be furnished without extra charge.
Mr. W.E. Code,
Asso. Irrigation Engr.,
Colorado Experiment Station
U.S. Dept. of Agriculture,
Fort Collins, Colorado.

Dear Mr. Code:-

I wrote you on May 1st quoting on a 4" centrifugal pump with 5 HP motor for Fort Lewis. I do not know whether you found this quotation in accordance with your desires, and if you wish us to make another quotation with texrope drives for two speeds, please let us have the information requested in regard to the head under the various conditions.

We have recently developed sheaves of variable pitch diameter which we might apply to your proposition, so that you would require only one set of pulleys and ropes, and it would be easier to make a change in speed. However, it would be necessary to refer this matter to our factory, and before doing so we would like to hear from you as to whether the figures we gave in our letter of May 1st are in accordance with yours.

Thanking you for your advice, we are,

Very truly yours,

ALLIS CHALMERS MFG. COMPANY

[Signature]

WRJ W
MANAGER DENVER OFFICE.
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Description</th>
<th>Hardness Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1508 ft</td>
<td>1</td>
<td>14 ga. galv. welded copper</td>
<td>2.20</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>bonding steel, dipped</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1508 ft</td>
<td>1</td>
<td>16 ga. steel</td>
<td>3.78</td>
<td>3.78</td>
</tr>
<tr>
<td>1508 ft</td>
<td>1</td>
<td>16 ga. galv. welded Throat</td>
<td>4.14</td>
<td>4.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron, dipped</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1508 ft</td>
<td>1</td>
<td>12 ga. black dipped</td>
<td>2.44</td>
<td>2.44</td>
</tr>
<tr>
<td>1508 ft</td>
<td>1</td>
<td>14 ga. black</td>
<td>2.44</td>
<td>2.44</td>
</tr>
<tr>
<td>1508 ft</td>
<td>1</td>
<td>6 x 8 increases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>6&quot; x 15&quot; long</td>
<td>3.92</td>
<td>3.92</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>6&quot; x 18&quot; long</td>
<td>4.06</td>
<td>4.06</td>
</tr>
<tr>
<td>5*17</td>
<td>5</td>
<td>6&quot; x 12&quot; long</td>
<td>4.24</td>
<td>4.24</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>6&quot; T's with blind flanges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>4&quot; T with nipple, 25% flanges</td>
<td>1.94</td>
<td>1.94</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>4 x 6&quot; increases, 25% flanges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>4&quot; used gated values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>6&quot; 50° El.</td>
<td>1.94</td>
<td>1.94</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>6&quot; 90° El.</td>
<td>1.94</td>
<td>1.94</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>8&quot; channel iron</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>71.08</td>
<td></td>
</tr>
</tbody>
</table>

**Total: 77.18**
A blue print showing the end fitting for the present system (No.27) is also submitted for information to the fabricator.

Should it be considered inadvisable at this time not to continue the 4-inch pipe to the north, then the end of the pipe should be left with a blind flange on a threaded pipe so that in the future a valve can be installed.

The necessary 2-inch pipe and fittings are to be installed after the 4-inch line is laid.

To shut off the water in the pond a 10-inch plain slide gate on a 10-inch tile bell is required. This gate must have a double handle in order to avoid a 5-inch steel drain pump from the "ducking pond." A gate of this type can be furnished by Giddings Machine Shop or most Denver manufacturers.

July 20, 1934
During, complete equipment 182 - 198 fittys
Washington, less pipe & foot valve 350
garl 285
complete 2 r. #2
285.30
Form 948-4

Cylinder No.          Date...

Dictated by...

Transcribed by...

Patented September 2nd, 1907—U. S. No. 865555.

TAE DICTAPHONE
(REGISTERED)

DICTATE YOUR INSTRUCTIONS FOR CORRECTIONS, CHANGES, ETC.
MAKE A CHECK (✓) ON SCALE AT POINT WHERE CORRECTION IS MADE, OR OTHER INSTRUCTIONS GIVEN.
OPERATOR SHOULD LISTEN AT POINTS CHECKED BEFORE WRITING.

Length of Letters

0 5 10 15 20 25 30 35 40 45 50 55

CAREFUL DICTATION WILL ENSURE PERFECT LETTERS
HOLD MOUTHPIECE CORRECTLY
SPEAK DISTINCTLY
SPELL PROPER NAMES
June 28, 1935.

Hendrie & Bolles, 
1635 Seventeenth St., 
Denver, Colorado.

Attention: Mr. J. M. Rihn.

Dear Mr. Rihn:

A feature of our pumping installation at Fort Lewis has been giving me a little trouble mentally in that I am not sure if we are safe in putting a foot valve on our suction pipe. Perhaps you will recall from our correspondence that we have a pipe line nearly 900 feet long, and the static head is about 7½ feet. What do you think will happen when the pump is shut off? Will the water hammer be hazardous to the pump unit? The only alternative that I see at this time is to introduce a check valve in the discharge line near the pump. I believe that the water hammer would be more serious in this long line than it would be in the line to the west, the length of which is 125 feet and the static lift 17 feet.

Your advice on this subject would be greatly appreciated.

Yours very truly,

W. E. Code, 
Associate Irrigation Engineer.
June 13, 1935.

Hendrie & Bolthoff,
1635 Seventeenth St.,
Denver, Colorado.

Attention: Mr. J. M. Rihn.

Dear Mr. Rihn:

Responding to your letter of the 10th May I inform you that several days ago the State Purchasing Agent was furnished with the request to purchase the Deming pump which you offered in your quotation of May 2.

In finally arriving at the size of pulleys required, I hope you will give this matter your close attention; selecting the size so as to give the maximum efficiency for the conditions. I believe you should count on 450 g.p.m. against a head of 26 or 27 feet and for the slow speed, 350 g.p.m. against a head of 21 feet.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

WEC:1s
June 10, 1935

W. E. Code,
Associate Irrigation Engineer,
Fort Collins, Colorado.

Subject: FORT LEWIS SCHOOL OF AGRICULTURE - PUMP

Dear Sir:

Under date of May 24th we had the pleasure of quoting you, in addition to our quotation of May 2nd, on Deming pumps and as we have not heard from you regarding these quotations, we are wondering whether our recommendations fully covered your requirements and if we may hope to be favored with your order in the near future.

Thanking you in advance for this information, we remain

Yours very truly,

HENDRIE & BOLTHOFF MFG. & SUPPLY CO.

J. M. Rihn--BP

---

ALL SALES AND CONTRACTS MADE BY US ARE EXPRESSLY SUBJECT TO THE FOLLOWING TERMS:

STENOGRAPHICAL AND CLERICAL ERRORS SUBJECT TO CORRECTION. PRICES SUBJECT TO CHANGE WITHOUT NOTICE. QUOTATIONS HEREBIN UNLESS OTHERWISE STATED ARE FOR IMMEDIATE ACCEPTANCE. ALL AGREEMENTS MADE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL.

OUR LIABILITY FROM ALL CAUSES IS LIMITED TO THE VALUE OF THE GOODS SOLD OR FURNISHED. IF GOODS ARE DEFECTIVE WE WILL NOT BE RESPONSIBLE BEYOND THE VALUE OF THE DEFECTIVE PIECE AT THE FACTORY, NOR WILL WE IN ANY WAY BE RESPONSIBLE FOR ANY DAMAGES OR EXPENSES OCCASIONED BY DEFECTIVE GOODS.
400 gpm. \[ f = \frac{20}{1000000} = \frac{.85}{20} = \frac{.85}{17.0} \]

350 \[ f = \frac{13}{1000000} \]

\[ f = \frac{13}{11.05} \]

450 against head of 25:

East 7.5 \[ \frac{1.3}{7} \]

West \[ \frac{8.5}{2.5} \]

25.2 \[ \frac{21.0}{21.0} \]

400 gpm and 23'.44

350 gpm head 20 feet

East 7.5 \[ \frac{1.1}{7} \]

West \[ \frac{18.5}{1.6} \]

19.2 \[ \frac{23.1}{23.1} \]

Give pump dimensions for installation plans and distance between siphon meter. Indicate if case is tapped for drain at low point.
Dear Mr. Code:

We have given your letter of June 18th considerable thought. There is no doubt but what you will be bothered with water hammer in your 900 ft. line, and it will be necessary to provide a suitable check valve in the discharge line as we are sure that the water rushing back when the motor is turned off will in time completely wreck the pump, or, at least, do serious damage to the impeller. With the check valve in the line, your present method for priming, namely, a foot valve, should be satisfactory.

Yours very truly,

HENDRIE & BOLTHOFF MFG. & SUPPLY CO.

J.M. Rihn--EP
April 30, 1935.

Mail address Box 807 Areak 10

Martin Iron Works,
1227 East 28th St.,
Los Angeles, California.

Gentlemen:

Would you please be so kind as to quote prices on
4 No. 6½ Type B, alfalfa valves and 2 No. 8½ Type B,
alalfa valves, f. o. b. Denver, Colorado.

We are doing some more pipe line work here and also
at the Fort Lewis School, and since the pipe will be
fabricated in Denver, I should want them to be shipped
there when ordered.

We are, at the present time, placing an order through
the State Purchasing Agent in Denver for a No. 10, Type
H gate and a No. 12, Type I gate. These would be shipped
to Fort Collins.

Our catalog of your devices has disappeared, and
we should like to have you provide us with another.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
UNION PACIFIC SYSTEM
UNION PACIFIC RAILROAD COMPANY
OREGON SHORT LINE RAILROAD COMPANY
OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY
LOS ANGELES & SALT LAKE RAILROAD COMPANY
THE ST. JOSEPH AND GRAND ISLAND RAILWAY COMPANY

STRAIGHT BILL OF LADING—ORIGINAL—NOT NEGOTIABLE

LOS ANGELES & SALT LAKE RAILROAD COMPANY

RECEIVED, subject to the classifications and tariffs in effect on the date of issue of this Original Bill of Lading,

at

from

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown) marked, consigned and declared as indicated below, which said company (the said company being inserted throughout this contract as meaning any person or corporation in possession of the property under this contract) agrees to carry to its usual place of delivery at said destination. If on its own road or its own water line, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, so to each carrier of all or any part of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service to be performed hereunder shall be subject to all the conditions as prohibited by law, whether printed or written, herein contained, including the conditions on back hereof, which are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to,

Destination

State of

County of

Route

(Delivering Carrier)

Car Initial

Car No.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION OF ARTICLES, SPECIAL MARKS, AND EXCEPTIONS</th>
<th>WEIGHT (Subject to Correction)</th>
<th>CLASS OR RATE</th>
<th>CHECK COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Iron Bars</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges. (See Section 7 of conditions.)

(Signature of consignor)

If charges are to be prepaid, write or stamp here, "To be Prepaid.

Received $ to apply in prepayment of the charges on the property described hereof.

Agent or Cashier

Per

(The signature here acknowledges only the amount prepaid.)

Charges advanced:

$__________________

__________________ Shipper.

Per. ________________________

Agent.

Permanent postoffice address of shipper.
CONTRACT TERMS AND CONDITIONS

Sec. 1. (a) The carrier or party in possession of any of the property herein described shall be liable as at common law for any loss thereof or damage thereto, except as hereinafter provided.

(b) No carrier or party in possession of all or any of the property herein described shall be liable for any loss thereof or damage thereto or delay caused by the act of God, the public enemy, the act or omission of the owner or agent of the consignor, or of any other person, public or private, for whose act or omission the carrier or party in possession shall be liable, or by fire, flood, tempest, explosion, or casualty to which the property is exposed in transit, or by any peril, loss, or damage occurring after the expiration of the time allowed by tariffs lawfully fixed (in the case of time to be computed therein provided) after notice of the arrival of the property at the point of destination or at the place of delivery as provided for in the bill of lading or otherwise, or in the exercise of the owner's right to sell the property or otherwise dispose of it as hereinafter provided, or in the manner of sale or mode of transportation chosen by the owner's agent, or by compliance with any order of any court, administrative authority, or by any other cause beyond the control of the carrier or party in possession.

Sec. 3. (a) Wherever property is delivered to the carrier for transportation the carrier shall be entitled to the full and entire proceeds of the sale or mode of disposition made in accordance with the terms of this section

(b) Wherever property is delivered to the carrier for transportation, the property shall be deemed to have been sold at public auction and the proceeds of the sale shall be the property of the owner thereof, and the carrier shall have the right to retain and apply the proceeds of the sale or mode of disposition made in accordance with the terms of this section.

Sec. 6. (a) No carrier or party in possession of all or any of the property herein described shall be liable as at common law for any loss thereof or damage thereto, except as hereinafter provided;

(b) No carrier or party in possession of all or any of the property herein described shall be liable for any loss thereof or damage thereto, except as hereinafter provided;

(c) No carrier or party in possession of all or any of the property herein described shall be liable for any loss thereof or damage thereto, except as hereinafter provided;

(d) No carrier or party in possession of all or any of the property herein described shall be liable for any loss thereof or damage thereto, except as hereinafter provided;

(e) No carrier or party in possession of all or any of the property herein described shall be liable for any loss thereof or damage thereto, except as hereinafter provided;

Sec. 10. Any alteration, addition, or erasure in this bill of lading which shall not be made without the special notations hereon of the agent of the carrier issuing this bill of lading, shall be without effect, and this bill of lading shall be enforceable according to its original terms.
May 16, 1935.

Hardesty Manufacturing Co.,
3063 Blake St.,
Denver, Colorado.

Gentlemen:

The enclosed drawing represents a pipe line required in connection with a pumping plant at Fort Lewis. We would like to invite bids on this piping as well as certain accessories listed by items on an enclosed sheet.

As shown on the profile at station 8 - 84.8 the line will start from the spigot end of an 8-inch T facing west on an existing 14 gage welded pipe line. We would like prices on 14 gage black dipped steel pipe and 16 and 14 gage galvanized riveted and dipped pipe. All prices shall be stated f.o.b. Hesperus, Colorado.

At the present time it is not known whether the pump will be 4-inch or 5-inch, hence the specifications may be changed at the time when this information becomes available, and before fabrication will be started on the pipe line. It is also for this reason that two sizes of gate valves at the pump are considered in the list of items.

No details are yet available on the so-called south extension, and the quantities are approximate only. Details will be available shortly.

Very truly yours,

W. E. Code,
Associate Irrigation Engineer.

Enc.
Colorado State Agricultural College
Fort Collins, Colorado

Gentlemen:

Attention -- Mr. W. E. Code
Associate Irrigation Engineer

In accordance with details furnished on material list and drawing attached to your letter of May 16, we are glad to quote you on the pipe required for the pumping plant at Fort Lewis School, Hesperus, Colorado, as follows, all prices being f.o.b. Hesperus:

(1) 1008.3 ft. of 6" O.D. Hardesty 14 gauge electric welded hot asphalt dipped steel pipe, with slip joint ends $564.65

(2) 1 - 6" to 8" increaser attached to pipe section, with hub or spigot end for joining to 8" Tee on pipe in place. (Labor charge only for forming increaser) 2.20

(3) 1 - 6" O.D. riser, 15" long, light flange on one end 3.92

(4) 1 - 6" O.D. riser, 18" long, light flange on one end 4.06

(5) 2 - 6" O.D. risers, 12" long, light flange on one end each 7.56

(6) 2 - 6" Tees with blind caps 4.83

(7) 1 - 5" Tee, stem 2 ft. long, threaded for flange furnished by you, with light flange on each end of 6" pipe run. 2 - sets of bolts and gaskets for above 6" flanges on Tee 3.68

(8) 2 - 5" to 6" increasers, light flange on one end of each 6.44

(9) 2 - new 5" iron gate valves, non-rising stems, flanged 63.62

(10) 2 - reconditioned gate valves, same as above. None Available.

(11) 2 - new 4" iron gate valves, non-rising stems, flanged 47.00

(12) 2 - reconditioned 4" gate valves, same as above 21.00.

(13) 1 - 5-degree elbow formed in 6" pipe. labor charge only 1.94

(14) 1 - 20-degree elbow formed in 6" pipe, labor charge only 1.94
COLORADO AGRICULTURAL COLLEGE
Fort Collins, Colorado

(15) 1 - 2" x 4" channel iron 15" long, drilled with two
13/16" holes as shown on drawing $1.00

(16) Approx. 500 ft. of 6" O.D. 14 gauge welded pipe, same
description as Item 1 above. Per foot $.56 $280.00

(17) 3 - 6" O.D. risers, 12" long, same as Item 5 above 11.34

As an alternate for Items 7, 8 and 9 above we offer the follow­ing:

(7a) 1 - 5" Tee, stem 4" or 5" x 2 ft. long, threaded for your
flange, run of pipe 6" diameter with light flange on
each end of run. $3.68
2 - sets of bolts and gaskets for above 6" flanges on Tee .56

(8a) No increaser needed, but 2 flanges attached to pipe
sections. 2.56

(9a) 2 - 6" iron gate valves, flanged. Reconditioned 37.00

If you have any questions about any of the material we propose
to furnish we shall be glad to have you take them up with us.

We should appreciate your order.

Yours very truly,

E.L. Haines

B.

THE R. HARDESTY MANUFACTURING COMPANY
DENVER, COLORADO

5/23/35
Colorado State Agricultural College
Fort Collins, Colorado

Gentlemen:

Attention -- Mr. W. E. Code
Associate Irrigation Engineer

Supplementing our letter to you of today in which we quoted on 17 pipe items for use in connection with the pumping plant at the Fort Lewis School, Hesperus, Colorado, we are pleased quote on 12 gauge pipe as an alternate for the 14 gauge 6-inch O.D. pipe, covered by Items 1 and 16 of our complete quotation, as follows, these prices being f.o.b. Hesperus, Colorado:

(1) 1008.3 ft. of 6" O.D. Hardesty 12 gauge electric welded hot asphalt dipped steel pipe, with slip joint ends.
   Per foot $ .77
   Total $776.39

(16) Approx. 500 ft. of 6" O.D. 12 gauge welded pipe, same description as Item 1 above.
   Per foot $ .77
   Total $385.00

Yours very truly,
THE R. HARDESTY MFG. CO.

E.L. Haines

[Signature]
<table>
<thead>
<tr>
<th>Item</th>
<th>Hardesty Unit</th>
<th>Hardesty Total</th>
<th>Thompson Unit</th>
<th>Thompson Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>.625</td>
<td>$942.50</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>.505</td>
<td>781.54</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.565</td>
<td>882.18</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6x8 increaser</td>
<td>2.20</td>
<td>2.20 1.90</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8&quot; riser 15&quot; long</td>
<td>3.92</td>
<td>3.92 3.75</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8&quot; 18&quot;</td>
<td>4.05</td>
<td>4.05 4.00</td>
<td></td>
</tr>
<tr>
<td>5 &amp; 17</td>
<td>8&quot; 12&quot;</td>
<td>3.78</td>
<td>18.90 3.75</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3/4&quot; T's with blind flange</td>
<td>2.44</td>
<td>4.88 4.45</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>4&quot; T's with nipple (question as to flanges)</td>
<td>4.24</td>
<td>4.24 8.00</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4x8&quot; increasers (question as to flanges)</td>
<td>3.50</td>
<td>7.00 1.62</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>4&quot; used gate valves</td>
<td>10.50</td>
<td>21.00 11.75</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>8&quot; 5-degree el.</td>
<td>1.94</td>
<td>1.94 1.62</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>8&quot; 20-degree el.</td>
<td>1.94</td>
<td>1.94 1.62</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>8&quot; channel iron</td>
<td>1.00</td>
<td>1.00 1.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$71.08</td>
<td></td>
<td>$77.18</td>
<td></td>
</tr>
</tbody>
</table>
June 14, 1935.

Fairbanks, Morse & Co.,
1941 Market St.,
Denver, Colorado.

Attention: Mr. M. A. Walters.

Dear Mr. Walters:

I had expected to see you again the day following your visit here, and at that time would have extended my thanks to you for your quotation of May 25 on the Fort Lewis School pump unit. It was decided that a Deming pump furnished by Hendrie & Bolthoff would more nearly fit our desires, and the order was placed with them.

Were you able to satisfy Mr. Dinner with either of the pumps you spoke to me about? Evidently there was no difficulty or I would have seen you.

Some of these days I shall return that manuscript copy of your talk to the well drillers made three or four years ago. I seem unable to remember this whenever I have made visits to your office.

Thanking you again, I am

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
W. E. Code, Associate Irrigation Engineer
Irrigation Investigations
Colorado Experimental Station
Fort Collins, Colorado

Dear Mr. Code:

We wish to thank you for the opportunity of supplying quotation covering your centrifugal pump specifications for the Fort Lewis School. However, the head is so low we do not have very much choice, in fact in the cheaper pumps we are limited almost to one type which is our Fig. 5520 line. The performance of the Fig. 5510 which is an open impeller type pump does not look so good on this very low head.

In quoting the writer has given you the choice of two starters - one is the standard push button starter cross-the-line type with low voltage protection. The other is the safety switch with three fuse-trons.

With regard to that part of your letter which covers the installation of two sets of sheaves on each the pump and motor that you might step the pump speed up sufficiently to give you 450 gallons of water instead of 400 gallons, we do not have shaft projection sufficient to accommodate two sheaves, therefore we have figured one sheave extra and will say it is a very simple matter in case you want to pump 450 gallons of water a minute to change sheaves using the same belts and give you the additional speed. Of course you appreciate, Mr. Code, that thru special construction we could have the shafts of both the motor and pump extended to accommodate both sheaves but it would be quite costly.

**PUMP**

1 - 4" Fig. 5522 Ball Bearing Horizontal Side Suction Pump, closed impeller, to deliver 400 gallons per minute against a total head of 23 ft. at 925 R.P.M. Pump efficiency 61%. Basic Pump with standard flanges, bolts and gaskets, net 30 days F.O.B. Hesperus, Colorado - $97.20. Deduct $4.20 if standard flanges, bolts and gaskets are not wanted.
MOTOR

1 - 5 HP Fairbanks-Morse Ball Bearing 1800 speed, 3 phase, 440 volt motor with base, net 30 days F.O.B. Hesperus, Colorado - $75.60.

DRIVE

1 - V belt drive complete with Fairbanks-Morse Flex-Mor or Gates Vulco Rope, consisting of two 6B belts, sheaves pitch diameter 6.0" and 11.0". Ratio 1.83 to 1. Centers approximately 18". Net 30 days F.O.B. Hesperus, Colorado - $23.62.

Add to the above prices the following net costs for the equipment hereafter specified:

1 - extra sheave to step speed of pump up to deliver 450 gallons per minute - $8.89.
1 - stainless steel shaft for above pump - $37.50.
1 - bronze impeller for above pump - $14.25.
1 - standard cross-the-line starter with low voltage protection - $7.56.
1 - safety switch with three fusetrons - $10.80.

Prices on all the add-to equipment are net 30 days F.O.B. Hesperus, Colorado.

We attach hereto bulletins covering the pump and motor and invite you to call on us if there is any additional information you desire regarding this equipment.

Yours very truly
Fairbanks, Morse & Co.

By M. A. Walters

MAW/FD
Encl.

#264.62
FAIRBANKS-MORSE

FIG. 5520 AND FIG. 5530

CENTRIFUGAL PUMPS

BALL BEARING - HIGH EFFICIENCY - SINGLE STAGE - SIDE SUCTION

The Fairbanks-Morse Fig. 5520 and Fig. 5530 ball-bearing centrifugal pumps are the most remarkable line of side suction pumps ever developed. Here is a line of low priced, highly efficient pumps, built of the finest materials with many unique features of design, that offers more value per dollar than found in any pump here-tofore presented to the trade.

Compared detail by detail with any other side suction pump the Fig. 5520 and Fig. 5530 line stands pre-eminent in the field of hydraulic design. They are of compact, sturdy construction especially designed for general service and heavy duty in sizes from one to eight inches for capacities from 25 to 2200 gallons per minute against heads up to 120 ft.

From the purchasers standpoint the world-wide distribution and service facilities of Fairbanks, Morse & Co. are extremely important. No matter where these pumps may be installed, the services of the organization stand back of the product. Where motor-driven pumps are desired the purchaser is assured that with F-M motors the units will operate at high overall efficiency with freedom from mechanical troubles.

The 1, 1\(\frac{1}{4}\), 1\(\frac{1}{2}\) and 2-inch Fig. 5590 and 1, 1\(\frac{1}{4}\) and 1\(\frac{1}{2}\)-inch Fig. 5530 pumps are built in the frame design shown in the view at the right. The larger frames, which include the 1, 1\(\frac{1}{2}\), 2, 3, 4 Fig. 5530 pumps and the 4, 5, 6 and 8-inch sizes of the Fig. 5520 pumps are of the type shown at the left. Both frames include the same unusual features of design not previously incorporated in a side-suction pump.
The smaller Fig. 5520 and Fig. 5530 pumps are equipped with frames as shown here. The essential difference between these two pumps is that the Fig. 5530 pump has a larger diameter volute and impeller than the Fig. 5520 pumps. In the 1, 1½, 2½ and 2-inch Fig. 5520 and all Fig. 5530 pumps no hydraulic balancing devices are used, hence the packing is never under suction but always under pressure and requires no water seal. The volute (1) of unusually efficient hydraulic design is bolted to the heavy frame (2). The blade angles and water channels of the impeller (3) are calculated to produce the most efficient characteristics. The sturdy shaft is carried on oversize bearings (4 and 5), the latter carrying the thrust and is securely held in place. The lubrication chamber is positively sealed by a labyrinth ring (6). A water seal connection opening (7) is provided for use when required.

**Equipped With the Highest Grade Ball-Bearings**

Unusual as it may seem this moderately priced pump is equipped with the highest grade ball bearings in the world. This application of such a costly type of bearing construction is all the more remarkable when it is considered that this line of pumps is priced no higher than many sleeve bearing side suction pumps.

**Ball Bearings do not wear appreciably**

In addition to improving the overall efficiency the application of ball bearings gives an exceptionally high degree of dependability through long life. There is no appreciable wear on ball bearings and consequently the shafts are held in permanent alignment maintaining the proper clearances between pump impellers and casings. The bearing housings exclude dirt and other undesirable particles. Maintenance is minimized in that it is necessary to pack grease in the large housing only once or twice a year for ordinary service.

The accompanying sectional views of these pumps show the application of these deep-groove over-size bearings. On the pulley end of the smaller frame a heavy single-row bearing is used and in the larger frames a double-row bearing has been adopted. These bearings provide an ample factor of safety for handling radial load, end thrust of the impeller and the side pull of belts. It will be noted that both bearings are mounted outside the pump casing hence they are unaffected by the liquid being pumped.

The ball bearing nearest the impeller is clamped on the shaft but is free to move axially in the bearing housing. At the driving end the bearing fits against a shoulder and is held in position by a large lock nut which is positively locked by a lock washer of a special form. A slight clearance is allowed in the housing so that the outer race can creep while the pump is in operation.

In order to prevent water from creeping along the shaft into the bearing and to keep the grease in the housing a labyrinth joint is used at the bearing nearest the impeller. This consists of a stationary
The larger Fig. 5520 pumps are equipped with a hydraulic balancing device and require a water seal as shown here. The larger Fig. 5530 pumps have frames similar to the one shown but have no balancing device and require no water seal but are provided with water seal connections for use when necessary. The well proportioned volute (1) which may have the discharge turned in any of eight positions is supported by a strong rigid frame (2). The sturdy impeller (4) and pulley are mounted on ends of the shaft which is protected from wear and corrosion at the stuffing box by a bronze shaft sleeve (3). The stuffing box on the larger Fig. 5520 pumps has a water seal (5). The shaft is carried on heavy oversize ball bearings, one of which (6) is for radial load and the other (7) carries the thrust as well as radial load. A labyrinth ring (8) seals the lubricating chamber.

**Refinements That Mean High Efficiency at Low Cost**

inner part and a revolving outer part. This simple device effectively seals the housing.

**Impeller and volute of highly perfected design**

The volute and impeller in these pumps are of especial interest from the standpoint of efficient hydraulic design, accessibility and interchangeability in application. Water passages are well proportioned to convert the velocity of the water, as it leaves the impeller, into pressure without undue loss from shocks or eddies. The enclosed type impellers of cast iron or bronze, as specified, are the last word in hydraulic design. The blade angles and water channels have been worked out to give this high efficiency over a wide range of operating conditions. Improved F-M foundry practice in one of the world’s greatest foundries produces smooth clean castings without the necessity of hand filing. Thus the original tough skin of the casting is untouched with the result that the durability and life of the impeller is improved.

The impeller is held to the shaft by a key and secured by means of an SAE cap screw on small pumps and a specially designed nut on the larger sizes. The shaft and complete bearing assembly may be removed through the pulley end of the housing after removing impeller.

**Frame is unusually heavy and rigid**

Interchangeability in the Fig. 5520 and Fig. 5530 line has been worked out to a degree never before offered in any line of pumps. There are only five frame sizes and yet these five frames are built into sixteen pump combinations. For instance, the No. 00 frame which is the smallest frame for the Fig. 5520 pump will carry a 1, 1 1/4, 1 1/2 and 2-inch volute. Thus if capacity conditions should change after installation it is possible to re-equip the pump with another size of volute and impeller.

The essential difference between the Fig. 5520 and the Fig. 5530 pump is that the latter has a larger diameter volute and impeller. The Fig. 5530 pump there-
Fairbanks-Morse Fig. 5520 and Fig. 5530 pumps incorporate exclusive features together with advancements and refinements of design and construction not to be found in other pumps of this type. Due to the facilities, experience and resources of Fairbanks, Morse & Co. the greater values in Fig. 5520 and Fig. 5530 pumps are available at low prices. The pumps have exceptionally rigid frames and strong bearings adapting them well for belt drive. The view to left illustrates the belt drive in large frame sizes while the view above shows one of the small pumps.

**Construction Features Reduce Maintenance and Increase Reliability**

Therefore is designed for higher head conditions. In both cases the frames consist of one piece construction carrying a support head for the volute, a base and bearing housing. The frames are built to withstand maximum side pull without distortion.

**Pump is well packed and easily repacked**

In pumps of this size and type it is especially important to consider the provisions for packing, the arrangements for dismantling the pump and the accessibility of the bearings. All of these points have a very definite relation to the successful operation and maintenance of a pump, particularly under severe service conditions.

A pump must be well packed and it should be easily repacked. The Fig. 5520 and 5530 line is of unusually good design in this respect. In the smaller frames there is space for six rows of packing. This is especially important because no water seal rings or water seal connections are used on these 1, 11/4, 1 1/2 and 2-inch sizes. No hydraulic balancing devices are used hence the packing is never under suction but is always under pressure.

The positive pressure on the packing provides sufficient water lubrication. If sand or other abrasive materials are encountered in the water a clear water connection must be provided for the packing to protect the shaft from excessive wear. In this case a special water seal ring can be provided.

On the 3-inch and larger sizes of the Fig. 5520 pumps the situation is somewhat different. On these larger pumps the axial thrust is greater and in order to relieve the ball bearings of most of this thrust load hydraulic balancing is used. This means, of course, that the space back of the impeller and the packing are under suction. A water seal connection taking water at discharge pressure is piped to the stuffing box as shown in
**sizes and capacities**

**fig. 5520 ball-bearing, centrifugal pumps**

<table>
<thead>
<tr>
<th>number of pump and size of discharge inches</th>
<th>figure number</th>
<th>size of suction inches</th>
<th>normal capacity at 1750 r.p.m.</th>
<th>code words</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1</td>
<td>5520</td>
<td>1 1/2</td>
<td>50</td>
<td>WACRC</td>
</tr>
<tr>
<td>*1 1/4</td>
<td>5520</td>
<td>1 1/2</td>
<td>80</td>
<td>WACSD</td>
</tr>
<tr>
<td>*1 1/2</td>
<td>5520</td>
<td>2</td>
<td>100</td>
<td>WACTE</td>
</tr>
<tr>
<td>*2</td>
<td>5520</td>
<td>2 1/2</td>
<td>125</td>
<td>WACUF</td>
</tr>
<tr>
<td>3</td>
<td>5522</td>
<td>3</td>
<td>350</td>
<td>WBEEO</td>
</tr>
<tr>
<td>4</td>
<td>5522</td>
<td>4</td>
<td>600</td>
<td>WBEFP</td>
</tr>
<tr>
<td>5</td>
<td>5522</td>
<td>5</td>
<td>800</td>
<td>WBGGR</td>
</tr>
<tr>
<td>6</td>
<td>5523</td>
<td>6</td>
<td>1300</td>
<td>WBEHS</td>
</tr>
<tr>
<td>8</td>
<td>5523</td>
<td>8</td>
<td>2000</td>
<td>WBEIT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>number of pump and size of discharge inches</th>
<th>figure number</th>
<th>size of suction inches</th>
<th>normal capacity at 1750 r.p.m.</th>
<th>code words</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1</td>
<td>5530</td>
<td>1 1/2</td>
<td>75</td>
<td>WADRB</td>
</tr>
<tr>
<td>*1 1/4</td>
<td>5530</td>
<td>1 1/2</td>
<td>120</td>
<td>WADSC</td>
</tr>
<tr>
<td>*1 1/2</td>
<td>5530</td>
<td>2</td>
<td>140</td>
<td>WADTD</td>
</tr>
<tr>
<td>*1</td>
<td>5531</td>
<td>1 1/2</td>
<td>100</td>
<td>WADQA</td>
</tr>
<tr>
<td>*1 1/2</td>
<td>5531</td>
<td>2 1/2</td>
<td>160</td>
<td>WADUE</td>
</tr>
<tr>
<td>2</td>
<td>5531</td>
<td>3</td>
<td>250</td>
<td>WADFV</td>
</tr>
<tr>
<td>3</td>
<td>5532</td>
<td>4</td>
<td>500</td>
<td>WADWG</td>
</tr>
<tr>
<td>4</td>
<td>5532</td>
<td>5</td>
<td>800</td>
<td>WADXII</td>
</tr>
</tbody>
</table>

* suction and discharge connections are tapped in volute on these sizes.
† for other capacities and heads see pages 6 and 7.

**fairbanks-morse stands back of both pump and motor**

The sectional view of this pump. This water under pressure and the water seal ring prevent air from being drawn into the pump through the packing. Not only are the stuffing boxes of ample proportions but the packing gland travel covers the width of at least 1 1/2 rings of packing. This permits sufficient take-up so that the pump does not have to be repacked frequently. Ample space is provided so that no difficulty is experienced in getting the packing into the stuffing box or in taking up on the gland. Furthermore, the stuffing box drip basin is unusually deep.

**shafts are exceptionally heavy and strong**

Fairbanks-Morse Fig. 5520 and Fig. 5530 ball-bearing pumps have exceptionally heavy shafts forged from high grade, open hearth steel, turned, ground and polished. The shaft is tapered and keyseated for mounting the impeller which is held in place by a lock screw at the end of the shaft. At the driving end, the shaft is properly keyseated to receive a coupling or pulley. In sizes above 2 inches the shaft is protected through the stuffing box by a renewable bronze shaft sleeve which is pressed on to the shaft. The shaft sleeve is not used on the small sizes for the reason that the shaft is a comparatively inexpensive part of the total cost. It is therefore as practical to change the shaft as it would be to put in a sleeve in the extremely few cases where this might be necessary.

**equipped for direct connection or belt drive**

This line of pumps is built for direct-connection as well as belt drive. Equipped with F-M ball-bearing motors they make up a complete ball-bearing unit free from mechanical troubles experienced when sleeve-bearing motors are used. Unit responsibility for both pump and motor eliminates service difficulties experienced when a pump is purchased from one manufacturer and the motor from another.

The bedplates for direct connected units are of two types. In sizes of 1, 1 1/4, 1 1/2 and 2-inch which are built on the No. 0 and No. 00 frames the base is made from heavy sheet steel plates welded together. In the larger sizes the bases are of cast iron or structural steel. Couplings between motor and pump are of the pin and bushing type.

Fairbanks-Morse standard pumps are of clockwise rotation. This rotation is clockwise when the pump is viewed from the driver end of the pump. Pumps with counter-clockwise rotation can be obtained if specially ordered.
Rating Chart for Fig. 5520 and Fig. 5530 Centrifugal Pumps Motor Drive

<table>
<thead>
<tr>
<th>Capacity</th>
<th>U. S. Gallons Per Minute</th>
<th>TOTAL DYNAMIC HEAD IN FEET OF WATER AND SIZE OF PUMP RECOMMENDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>8' 2000 RPM M.H.P.</td>
<td>1' 5520 1' 5520 1' 5520 1' 5520 1' 5520</td>
</tr>
<tr>
<td>50</td>
<td>8' 2000 RPM M.H.P.</td>
<td>1' 5520 1' 5520 1' 5520 1' 5520 1' 5520</td>
</tr>
<tr>
<td>75</td>
<td>8' 2000 RPM M.H.P.</td>
<td>2' 5520 2' 5520 2' 5520 2' 5520 2' 5520</td>
</tr>
<tr>
<td>100</td>
<td>8' 2000 RPM M.H.P.</td>
<td>3' 5520 3' 5520 3' 5520 3' 5520 3' 5520</td>
</tr>
<tr>
<td>125</td>
<td>8' 2000 RPM M.H.P.</td>
<td>4' 5520 4' 5520 4' 5520 4' 5520 4' 5520</td>
</tr>
<tr>
<td>150</td>
<td>8' 2000 RPM M.H.P.</td>
<td>5' 5520 5' 5520 5' 5520 5' 5520 5' 5520</td>
</tr>
<tr>
<td>175</td>
<td>8' 2000 RPM M.H.P.</td>
<td>6' 5520 6' 5520 6' 5520 6' 5520 6' 5520</td>
</tr>
<tr>
<td>200</td>
<td>8' 2000 RPM M.H.P.</td>
<td>7' 5520 7' 5520 7' 5520 7' 5520 7' 5520</td>
</tr>
<tr>
<td>250</td>
<td>8' 2000 RPM M.H.P.</td>
<td>8' 5520 8' 5520 8' 5520 8' 5520 8' 5520</td>
</tr>
<tr>
<td>300</td>
<td>8' 2000 RPM M.H.P.</td>
<td>9' 5520 9' 5520 9' 5520 9' 5520 9' 5520</td>
</tr>
<tr>
<td>350</td>
<td>8' 2000 RPM M.H.P.</td>
<td>10' 5520 10' 5520 10' 5520 10' 5520 10' 5520</td>
</tr>
<tr>
<td>400</td>
<td>8' 2000 RPM M.H.P.</td>
<td>11' 5520 11' 5520 11' 5520 11' 5520 11' 5520</td>
</tr>
<tr>
<td>450</td>
<td>8' 2000 RPM M.H.P.</td>
<td>12' 5520 12' 5520 12' 5520 12' 5520 12' 5520</td>
</tr>
<tr>
<td>500</td>
<td>8' 2000 RPM M.H.P.</td>
<td>13' 5520 13' 5520 13' 5520 13' 5520 13' 5520</td>
</tr>
<tr>
<td>600</td>
<td>8' 2000 RPM M.H.P.</td>
<td>14' 5520 14' 5520 14' 5520 14' 5520 14' 5520</td>
</tr>
<tr>
<td>700</td>
<td>8' 2000 RPM M.H.P.</td>
<td>15' 5520 15' 5520 15' 5520 15' 5520 15' 5520</td>
</tr>
<tr>
<td>800</td>
<td>8' 2000 RPM M.H.P.</td>
<td>16' 5520 16' 5520 16' 5520 16' 5520 16' 5520</td>
</tr>
<tr>
<td>900</td>
<td>8' 2000 RPM M.H.P.</td>
<td>17' 5520 17' 5520 17' 5520 17' 5520 17' 5520</td>
</tr>
<tr>
<td>1000</td>
<td>8' 2000 RPM M.H.P.</td>
<td>18' 5520 18' 5520 18' 5520 18' 5520 18' 5520</td>
</tr>
<tr>
<td>1100</td>
<td>8' 2000 RPM M.H.P.</td>
<td>19' 5520 19' 5520 19' 5520 19' 5520 19' 5520</td>
</tr>
<tr>
<td>1200</td>
<td>8' 2000 RPM M.H.P.</td>
<td>20' 5520 20' 5520 20' 5520 20' 5520 20' 5520</td>
</tr>
<tr>
<td>1300</td>
<td>8' 2000 RPM M.H.P.</td>
<td>21' 5520 21' 5520 21' 5520 21' 5520 21' 5520</td>
</tr>
<tr>
<td>1500</td>
<td>8' 2000 RPM M.H.P.</td>
<td>22' 5520 22' 5520 22' 5520 22' 5520 22' 5520</td>
</tr>
<tr>
<td>1800</td>
<td>8' 2000 RPM M.H.P.</td>
<td>23' 5520 23' 5520 23' 5520 23' 5520 23' 5520</td>
</tr>
<tr>
<td>2000</td>
<td>8' 2000 RPM M.H.P.</td>
<td>24' 5520 24' 5520 24' 5520 24' 5520 24' 5520</td>
</tr>
<tr>
<td>2200</td>
<td>8' 2000 RPM M.H.P.</td>
<td>25' 5520 25' 5520 25' 5520 25' 5520 25' 5520</td>
</tr>
</tbody>
</table>
### Rating Chart for Fig. 5520 and Fig. 5530 Centrifugal Pumps Belt Drive

<table>
<thead>
<tr>
<th>Capacity</th>
<th>TOTAL DYNAMIC HEAD IN FEET OF WATER AND SIZE OF PUMP RECOMMENDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
</tr>
<tr>
<td>175</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
</tr>
<tr>
<td>350</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td></td>
</tr>
<tr>
<td>450</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td></td>
</tr>
<tr>
<td>550</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td></td>
</tr>
<tr>
<td>700</td>
<td></td>
</tr>
<tr>
<td>750</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td></td>
</tr>
<tr>
<td>850</td>
<td></td>
</tr>
<tr>
<td>900</td>
<td></td>
</tr>
<tr>
<td>950</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>1050</td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td></td>
</tr>
<tr>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>1250</td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td></td>
</tr>
<tr>
<td>1350</td>
<td></td>
</tr>
<tr>
<td>1400</td>
<td></td>
</tr>
<tr>
<td>1450</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>1550</td>
<td></td>
</tr>
<tr>
<td>1600</td>
<td></td>
</tr>
<tr>
<td>1650</td>
<td></td>
</tr>
<tr>
<td>1700</td>
<td></td>
</tr>
<tr>
<td>1750</td>
<td></td>
</tr>
<tr>
<td>1800</td>
<td></td>
</tr>
<tr>
<td>1850</td>
<td></td>
</tr>
<tr>
<td>1900</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td></td>
</tr>
<tr>
<td>2150</td>
<td></td>
</tr>
<tr>
<td>2200</td>
<td></td>
</tr>
</tbody>
</table>
**Principal Dimensions**

Fig. 5520 and Fig. 5530 Pumps on No. 0 and No. 00 Frames

<table>
<thead>
<tr>
<th>Pump and Size</th>
<th>Size of Suction</th>
<th>Frame Number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Pulley Size Belt Drive</th>
<th>Center line of Pulley to Center line of Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; Fig. 5520</td>
<td>11 1/2&quot;</td>
<td>00</td>
<td>16%</td>
<td>14%</td>
<td>9%</td>
<td>23/4</td>
<td>53/4</td>
<td>6&quot;</td>
<td>4&quot; x 3&quot;</td>
<td>13 1/4&quot;</td>
</tr>
<tr>
<td>1 1/4&quot; Fig. 5520</td>
<td>11 1/2&quot;</td>
<td>00</td>
<td>16 1/2%</td>
<td>15%</td>
<td>9%</td>
<td>23/4</td>
<td>53/4</td>
<td>6 1/4&quot;</td>
<td>4&quot; x 3&quot;</td>
<td>13 1/4&quot;</td>
</tr>
<tr>
<td>1 1/2&quot; Fig. 5520</td>
<td>2&quot;</td>
<td>00</td>
<td>17 1/2%</td>
<td>15%</td>
<td>10 1/2%</td>
<td>35/4</td>
<td>53/4</td>
<td>5&quot;</td>
<td>4&quot; x 3&quot;</td>
<td>13 1/4&quot;</td>
</tr>
<tr>
<td>2&quot; Fig. 5520</td>
<td>2 1/2&quot;</td>
<td>00</td>
<td>18%</td>
<td>15%</td>
<td>10%</td>
<td>35/4</td>
<td>53/4</td>
<td>5 1/2&quot;</td>
<td>4&quot; x 3&quot;</td>
<td>13 1/4&quot;</td>
</tr>
<tr>
<td>1&quot; Fig. 5530</td>
<td>11 1/2&quot;</td>
<td>00</td>
<td>18 1/2%</td>
<td>16%</td>
<td>13%</td>
<td>41/4</td>
<td>73/4</td>
<td>7 1/4&quot;</td>
<td>5&quot; x 4&quot;</td>
<td>14&quot;</td>
</tr>
<tr>
<td>1 1/4&quot; Fig. 5530</td>
<td>11 1/2&quot;</td>
<td>00</td>
<td>18 1/4%</td>
<td>16%</td>
<td>13%</td>
<td>41/4</td>
<td>73/4</td>
<td>7 1/4&quot;</td>
<td>5&quot; x 4&quot;</td>
<td>14 1/4&quot;</td>
</tr>
<tr>
<td>1 1/2&quot; Fig. 5530</td>
<td>2&quot;</td>
<td>00</td>
<td>18%</td>
<td>16%</td>
<td>13%</td>
<td>41/4</td>
<td>73/4</td>
<td>7&quot;</td>
<td>5&quot; x 4&quot;</td>
<td>14&quot;</td>
</tr>
</tbody>
</table>

Fig. 5520 and Fig. 5530 Pumps on Nos. 1, 2 and 3 Frames

<table>
<thead>
<tr>
<th>Pump and Size</th>
<th>Size of Suction</th>
<th>Frame Number</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Pulley Size Belt Drive</th>
<th>Center line of Pulley to Center line of Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; Fig. 5522</td>
<td>3&quot;</td>
<td>2</td>
<td>2 1/4&quot;</td>
<td>2&quot;-0 3/4&quot;</td>
<td>16&quot;</td>
<td>6&quot;</td>
<td>10 1/2&quot;</td>
<td>6 1/4&quot;</td>
<td>8&quot; x 6&quot;</td>
<td>21 2/3&quot;</td>
</tr>
<tr>
<td>4&quot; Fig. 5522</td>
<td>4&quot;</td>
<td>2</td>
<td>2 1/4&quot;</td>
<td>2&quot;-1 1/4&quot;</td>
<td>17&quot;</td>
<td>6 1/4&quot;</td>
<td>10 1/2&quot;</td>
<td>7&quot;</td>
<td>8&quot; x 6&quot;</td>
<td>21 2/3&quot;</td>
</tr>
<tr>
<td>5&quot; Fig. 5522</td>
<td>5&quot;</td>
<td>2</td>
<td>2 1/4&quot;</td>
<td>2&quot;-1 1/4&quot;</td>
<td>18&quot;</td>
<td>6 1/4&quot;</td>
<td>10 1/2&quot;</td>
<td>7 1/4&quot;</td>
<td>8&quot; x 6&quot;</td>
<td>21 2/3&quot;</td>
</tr>
<tr>
<td>6&quot; Fig. 5523</td>
<td>6&quot;</td>
<td>3</td>
<td>3&quot;-0 7/8&quot;</td>
<td>2&quot;-7 3/4&quot;</td>
<td>22&quot;</td>
<td>7 7/8&quot;</td>
<td>12 1/4&quot;</td>
<td>8 1/4&quot;</td>
<td>10&quot; x 8 1/3&quot;</td>
<td>22 2/3&quot;</td>
</tr>
<tr>
<td>8&quot; Fig. 5523</td>
<td>8&quot;</td>
<td>3</td>
<td>3&quot;-2 3/4&quot;</td>
<td>2&quot;-7 3/4&quot;</td>
<td>23&quot;</td>
<td>8&quot;</td>
<td>12 1/4&quot;</td>
<td>10&quot;</td>
<td>10&quot; x 8 1/3&quot;</td>
<td>22 2/3&quot;</td>
</tr>
</tbody>
</table>

*1" Fig. 5531 | 1 1/4" | 2 1/4" | 18 1/4" | 4 1\%" | 5 1/2" | 6 1/4" | 10 1/2" | 7 1/4" | 6" x 3" | 16 1/4" |
*1 1/2" Fig. 5531 | 2 1/4" | 18" | 14" | 5 1/4" | 6" | 8" | 10 1/2" | 10 1/4" | 8" x 6" | 22 2/3" |
*2" Fig. 5531 | 2 1/4" | 18 1/4" | 15 1/4" | 5 1/4" | 6" | 8" | 10 1/2" | 10 1/4" | 8" x 6" | 22 2/3" |
*3" Fig. 5532 | 2 1/4" | 2 1/4" | 17 1/4" | 6" | 10 1/4" | 10 1/4" | 8" x 6" | 22 2/3" |
*4" Fig. 5532 | 2 1/4" | 18" | 11" | 6" | 8" | 10 1/4" | 8" x 6" | 22 2/3" |

*Suction and Discharge tapped in volute.

**Fairbanks, Morse & Co.**

Manufacturers

Executives Offices: Chicago, Ill.

Branches in Principal Cities

Publication APB211.2C

PRINTED IN U.S.A. 93410
Ball-Bearing Induction Motors

Type Q, Squirrel Cage—Type QLS, Line Start

Continuous Duty, Horizontal Shaft, Polyphase Induction Motors for Constant Speed Service

40 Degree Rating with Reserve Power

High Efficiency at Both Full and Partial Loads

Type Q Motor—A Quality Product

In the selection of an induction motor by the industrial purchaser, the most important consideration is the reliability of the motor, that is, its ability to render satisfactory service year after year under actual operating conditions. Fairbanks-Morse engineers have incorporated in the type "Q" and type "QLS" motors many practical refinements which have resulted in greater reliability and its consequent direct advantage to the customer. Careful and thorough research has been conducted by the engineering staff over a period of years, investigating the strength and weakness of all existing types, kinds and makes of induction motors. As a result of this comprehensive investigation, combined with the experience of over a quarter century in building electrical motors, a distinctive, quality-type motor with many practical refinements and superior reliability has been evolved.

Outstanding Mechanical and Operating Features

Sealed ball bearings mounted in removable shell housings.

Pressure cast aluminum rotor construction, with rotor bars, end rings and fan blades cast integral on smaller sizes.

Copper rotor bars electrically welded to the end rings and fan blades cast integral with the end rings on the larger sizes.

Substantial, rigid stator heads with feet cast integral.

Electrically welded zones across outer surface of stator laminations at several points, uniting the laminations into a solid mass.

Effective ventilation secured by directing air through the motor—eliminates hot spots. Laminations fully exposed to the outside air provides maximum radiating surface.

Stator end shields made heavy so as to rigidly support shaft, protect stator coils and direct the cooling air.

Permanently plastic insulating material which retains its original strength and insulating qualities unimpaired for years, carefully inserted slot insulation, points of unusual strain heavily reinforced.

Starting effort that provides quick start and rapid, smooth acceleration up to full speed under severe conditions.

Copyright 1929 by Fairbanks, Morse & Co.
The electrical characteristics of the type Q and type QLS motors, which give balanced electrical performance, do not in themselves permit full realization of the possibilities of the excellent design. Vast resources and years of experience in the manufacturing departments have also been utilized to produce superior mechanical features, resulting in a perfectly balanced product in which there is no compromise.

The manufacturing departments have provided the most substantial means to guarantee the high quality and successful operation of F-M motors. Special machinery and machine tools have been furnished to secure extreme accuracy. Entirely new manufacturing methods are being used to insure uniformity of quality. The shops are thoroughly organized to maintain the highest standards of workmanship and the most rigid tests and inspection. This system, which maintains the high standard of workmanship and rigid inspection, is the most important single contribution in recent years to the manufacture of reliable motors.

Economy

While the reliability of a motor is of major importance, it is equally essential that a motor be economical to operate. The cost of operating type Q and type QLS motors is low because of their excellent design and ball bearing construction. Ball bearings reduce mechanical losses, cut repair costs and practically eliminate bearing failures. The electrical efficiency is high, not only at full load, but at partial loads and the high power factor over the entire operating range cuts down the electrical losses.

Anti-Friction Bearings

The reliability and economy of ball bearings for electric motors has been thoroughly and conclusively demonstrated over a period of many years by the performance records of well over a quarter of a million Fairbanks-Morse general purpose ball-bearing motors in all kinds of service. Therefore, the engineers responsible for the type Q and type QLS motors naturally and logically selected anti-friction bearings.

A refinement has been incorporated in this design, however, by mounting the ball bearings in sealed shells, which permits the removal of the rotor without exposing the bearings to dust or corrosive gases which may be present. The sealed shells are absolutely dust tight and insure clean bearings.

Friction is reduced by self-aligning ball-bearings which lower the power costs and save enough to quickly repay their small extra cost.

Increased dependability is secured because of the practical elimination of bearing wear and the consequent long life prevents many accidents and shut-downs which arise primarily from bearing failures and electrical breakdowns caused by oil-soaked insulation.

Years of hard service are built into these bearings. Wear is almost imperceptible and evenly distributed. Dirt and dust are excluded by the dust-tight bearing assembly. The inner race is firmly locked on the shaft and clamped so that it cannot possibly turn on the shaft. It revolves with the shaft as a unit under all conditions of load. The outer race is just loose enough in the housing to creep slowly and wear evenly. There is no wear whatsoever on the shaft. Because of this, the air gap remains even and the efficiency and power factor do not change during years of service. There is no danger of rotor and stator touching because of bearing wear. Belt pull or gear pressure may be upward, downward or in any direction without reducing the bearing surface or in any way affecting the lubrication.

Maintenance is reduced since it is necessary to renew the grease only once a year, then it takes only a few minutes of one man's time. Grease is supplied in sealed dust-tight container tubes which insure the proper amount of clean, new grease and facilitate renewal of the grease. Replacements are seldom necessary although they are easily made inasmuch as the inner bearing closure is so designed to permit removal of the bearing without damage to it and no sep-
arate bearing pulley is necessary.

Insulation is protected as a result of tight bearing housings and grease packed bearings. Motor failures due to oil-soaked insulation are done away with.

A short, thick shaft is possible with ball bearings. Fairbanks-Morse has always taken advantage of the possibility of using heavy shafts in ball-bearing motors, but in order to secure additional reliability the shaft sizes have been increased in some instances and larger bearings used. In order to distribute strains, fillets are provided where a change is made in the shaft diameter.

**Rotor Construction**

Possible rotor troubles due to open circuited bars or end rings and high resistance spots are successfully prevented by the pressure cast aluminum construction of small and medium size motors. The rotor bars, end rings and fan blades are cast in one piece as a unit. The special method of manufacture provides an absolutely uniform rotor in which the rotor slots are perfectly filled. On the larger motors the deeper rotor bars and end rings are electrically welded so that a homogeneous structure is obtained throughout. In all cases sturdy fans are cast integral with the end rings.

**Frame and Stator**

The stator heads have the feet cast integral and are sturdily made throughout to withstand strains, and to hold the laminated core and bearings permanently rigid. Stator laminations of the best grade electric sheet steel are japanned on both sides by a special method and baked to reduce the iron losses. They are then stacked over an expanding arbor. By expanding this arbor to the required diameter every lamination assumes its proper position, thereby giving a smooth and accurate inside stator bore. Hence, a uniform accurate air gap is secured and because the ball-bearings wear so little this uniform air gap is retained during years of service and therefore unvarying operating characteristics are maintained.

After the laminations are expanded to the proper diameter the sturdy stator heads with feet cast integral are placed at each end of the stator core, which is then compressed the required amount by specially designed hydraulic presses; while under pressure the core and stator heads are riveted with tight-fitting rivets. To insure additional rigidity the outside surface of the laminated stator core is electric are welded in several places. This one solid mass which prevents shifting of the laminations. The result is the equivalent of a cast-frame motor with the added advantage of direct heat radiation from core to air.

The end shields are heavier than ordinarily used, designed to afford maximum protection to the stator windings and to hold the bearings in permanent alignment. At the same time they direct the path of air through the inside of the motor to ventilate it perfectly.

**Insulation**

The very heart of any motor is its insulation. No matter how sturdy in other respects, if the insulation does not remain flexible the motor will fail. Fairbanks-Morse type Q and type QLS motors are protected against electrical and mechanical failures by carefully inserted slot insulation and by liberal coatings of the very best extra flexible baking varnish which retains its flexibility after years of service.

Every slot is lined with thick layers of tough fibrous insulation so placed that the coils can not come in contact at any place with the iron of the core. Shaped, well insulated double cotton covered wire coils are carefully placed in the slots by expert workmen and extra insulation is used between phases.
Heavy End Shields Afford a Rigid Mounting for the Ball Bearings.

After the windings are in place they are impregnated with special heavy-body insulating varnish, moisture proof, acid proof and oil proof. The windings are dipped and baked, redipped and re-baked until they are thoroughly saturated and coated with this insulating compound which will not chip or flake and which remains permanently plastic. The windings are thus given a firm foundation for withstanding the stresses of full-voltage starting.

Ventilation

Unusually good ventilation is obtained and hot spots eliminated due to the exposure of the outside of all core laminations to the surrounding air, the shape of the end shields which direct the flow of the cooling air inside the motor, the heat radiating ability of the insulation and the well proportioned electrical design. All of these features combine to insure a low uniform operating temperature of all parts.

Performance

Type Q squirrel cage motors have been designed for good starting ability and high running performance. They will develop starting torques of from 150% at 1800 r.p.m. to 125% at 900 r.p.m., with reasonable starting currents, but slightly higher than that of the line start type QLS motors.

Type QLS line start motors 30 horsepower and less are designed for starting at full line voltage, by means of a simple across-the-line type of starter, with starting currents within the recommendations of the National Electric Light Association. The starting current is held within the limits because of the comparatively high rotor reactance at starting. This reactance is produced due to the shape of the rotor bars. At starting the rotor frequency is high so the rotor current flows through that part of the bar near the air gap, thus a relatively high starting torque is obtained. As the rotor accelerates the reactance of the rotor winding automatically diminishes permitting more current to flow through the entire section of the rotor bars until at normal speed the current drawn is in proportion to the motor load. Good efficiency, high full-load speed, normal starting torque, high pull-out torque and low starting current are obtained in this motor.

The QLS line start motors are suitable for such service where ordinarily the standard squirrel cage motors have been used. But because of the ready adaptation of the type QLS motors to the full voltage across-the-line type of automatic control, through pressure gauges, push button stations, float switches, etc., they are suitable for an extremely large field of application. When used with full voltage line starters they will develop starting torques of from 125% of normal torque at 900 r.p.m. to 150% of normal torque at 1800 r.p.m.

The efficiency and power factor of both the type Q and type QLS motors are high not only at full load but at partial loads. High power factor is obtained at all points between half load and full load and the efficiency decreases only a few points over the complete range from full load to half load.

The efficiency and power factor of the line start QLS motors are practically the same as those of the standard squirrel cage motors.

Temperature Guarantee

An abundance of reserve power is built into these motors to allow a great factor of safety even under extremely severe operating conditions, without excessive heating. The temperature rise will not exceed 40 degrees Centigrade when operating at full rated load continuously. The windings, insulation and mechanical parts of all Fairbanks-Morse general purpose induction motors, except fractional horsepower sizes, are so proportioned that they will operate successfully under 115% of their respective rated load continuously at rated voltage and frequency, within accepted safe limits of temperature rise.

Fairbanks, Morse & Co.

GENERAL OFFICES
900 South Wabash Avenue
CHICAGO, ILLINOIS

ELECTRICAL WORKS
2060 Northwestern Avenue
INDIANAPOLIS, INDIANA

Branches in All Commercial and Industrial Centers

Publication AEB401.6

Printed in U.S.A.

112905
Item #7 - 4" T with 4" standard pipe nipple.
West pipe line: 3/4" waste nut and plug at bottom 4' from flange.
East pipe line: 1/2" le
Fig. 1—a 34", 10-gage Weigele Riveted Steel Pipe Line for City of Denver.

Weigele Riveted Steel Pipe has been the standard of the West since 1878 for mining, irrigation, municipal and industrial purposes.
WEIGELE RIVETED STEEL PIPE

Unexcelled for Irrigation, Municipal... Power and Mining Purposes

RIVETED STEEL CONSTRUCTION FOR STRENGTH & SECURITY

—made of the finest of Copper Bearing Steels. (Copper-bearing steels are specified by the U.S. Government for pipe purposes.)
—covered with tough, pliable Mineral Rubber Pipe Coating by Hot Dip Process. Lasts indefinitely; gives protection against corrosion by acids or alkalis.
—doubly protected when pure zinc galvanizing as well as Mineral Rubber Coating is specified.

Made by the Oldest and Largest Manufacturer of Pipe in the Mountain States
Consult Our Engineering Department Without Charge or Obligation

Thompson Lock Seam Steel Pipe

When a light weight, durable Pipe is desired for very low heads—Thompson Lock Seam, Galvanized, Copper-Bearing Steel, hot-asphalt dipped Pipe will admirably meet your requirements. You will find our prices on Lock Seam Pipe most attractive.

Thompson Welded Steel Pipe

Thompson Welded Steel Pipe sets new standards for quality in its field. It is made in the same sizes and with the same joint connections in which Weigele Riveted Steel Pipe is supplied. Thompson is prepared to furnish Welded Pipes and contract the installation for any size project. Be sure to obtain Thompson prices before you buy Welded Pipe.
## Safe Working Pressures and Weights

Made of steel having ultimate tensile strength of 55,000 pounds per square inch. Double riveted longitudinal seams and single riveted girth seams. Joint efficiency of longitudinal joints, 70 per cent. Safe heads and pressures based on factor of safety of 4 or 13,750 pounds per square inch fibre stress.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>16</td>
<td>1.602</td>
<td>380</td>
<td>165</td>
<td>2.3</td>
<td>16</td>
<td>126</td>
<td>55</td>
<td>17.0</td>
<td>16</td>
<td>126</td>
<td>55</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>1.602</td>
<td>555</td>
<td>249</td>
<td>4.2</td>
<td>14</td>
<td>157</td>
<td>68</td>
<td>21.0</td>
<td>14</td>
<td>157</td>
<td>68</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>1.602</td>
<td>693</td>
<td>300</td>
<td>5.1</td>
<td>10</td>
<td>283</td>
<td>123</td>
<td>27.1</td>
<td>10</td>
<td>283</td>
<td>123</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>1.602</td>
<td>462</td>
<td>200</td>
<td>4.8</td>
<td>4</td>
<td>187</td>
<td>378</td>
<td>30.3</td>
<td>4</td>
<td>187</td>
<td>378</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>1.602</td>
<td>578</td>
<td>250</td>
<td>6.0</td>
<td>4</td>
<td>187</td>
<td>378</td>
<td>30.3</td>
<td>4</td>
<td>187</td>
<td>378</td>
</tr>
</tbody>
</table>

---

The THOMPSON MANUFACTURING CO. DENVER, COLO.
Only Riveted Steel Pipe Could Stand This Punishment

Fig. 11.—Unretouched Photograph of 30" diameter Weigele Riveted Steel Pipe manufactured and installed by The Thompson Manufacturing Company for The Western Colorado Power Company in 1923.

Fig. 12.—Unretouched Photograph of above Weigele Riveted Steel Pipe Line taken immediately after the disastrous floods of July, 1929. The Timber truss bridge was completely destroyed and washed away; the river banks were washed out; trees were torn up and thrown against the Pipe Line. The Pipe was left unsupported for a clear span of 60' with the water filled with refuse raging 8' over the top of it, and yet the Pipe Line held and continued to do its work undamaged. Weigele Riveted Steel Pipe is built to endure under the most severe conditions.

Use Riveted Steel Construction for Strength and Security

OTHER THOMPSON PRODUCTS

- Metal Flumes
- Well Casing
- Measuring Flumes
- Corrugated Culverts
- Steel Stacks
- Steel Tanks
- Warm Air Furnaces
- Steel Specials
June 22, 1935.

Dean E. H. Bader,
Fort Lewis School,
Hesperus, Colorado.

Dear Dean Bader:

I am returning the sketch that you sent me on the pipe line layout. At the south end the angles do not check for parallel between the two east and west lines. Perhaps you should have written 105 degrees instead of 115. The angle marked 75 degrees, of course, is not possible, and I am not certain to which it applies, and 75 and 115 make 190 degrees. Before I can submit specifications to Thompson, I must be certain of this angle.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
June 4, 1935.

Mr. E. H. Bader,
Acting Dean,
Fort Lewis School,
Hesperus, Colorado.

Dear Mr. Bader:

In answer to your inquiry of May 31, I am enclosing a blue print of the pipe line from the pumping plant and includes a design for the pumping station. The plans do not take into consideration the exact location topographically of the pipe line, it being my idea that it would follow the line of survey which you made. The pipeline at the south end of the campus will be fabricated to meet the plans that you submitted in a sketch.

In a discussion with Dr. Lory regarding the class of pipe we should use, it was decided Tocan metal galvanized, 16 gage would give the longest life of any of the metals available. This, of course, will be riveted and will have a little higher friction factor than the straight welded pipe. Mr. Garrett of the Thompson Manufacturing Company who will furnish this assured me that it would have far greater life than 14 or 18 gage black welded and dipped pipe. Because this metal is not carried regularly in stock there will be two or three weeks delay in shipment from Denver beyond the ordinary delivery time. It would appear then that it would be towards the end of the present month before materials will arrive.

At the same consultation with Dr. Lory we decided on a Deming 4-inch pump and 5-horsepower motor. The sheaves will be furnished for the motor which will drive at speeds so as to be efficient to pump 450 and 350 g.p.m. This is an inexpensive pump, but the characteristic curves show it to be quite efficient. Ordinarily this pump would be shipped from stock in Denver by Hendry & Bolthoff, but because we thought that a stainless steel shaft and a bronze impeller will materially add to the life of the pump it will have to be shipped from the factory. This will cause a delay of about two weeks and will fit in very nicely with the delivery date of the pipe.
No doubt you would want to have an earlier delivery of this pipe to fit in with the work for the boys, but I feel that we were justified in accepting this delay to get the best material and equipment for the job.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
Mr. W. E. Code
Experiment Station
Fort Collins, Colorado

Dear Mr. Code:

A number of boys are anxious to work on the campus this summer, and we should like to get them started on the pipe line digging. Do you have your plans sufficiently materialized so that we may have your final sketch as to the proposed pumping plant and line leading from it? If we may have these soon we shall begin the work of excavating and of digging for the pipes. About when may we expect delivery of the materials for installation?

Hoping all is going well with you, I am

Very truly yours,

E. H. Bader

E. H. Bader,
Acting Dean
April 30, 1935.

Mr. E. H. Bader,
Acting Dean,
Fort Lewis School,
Hesperus, Colorado.

Dear Mr. Bader:

In addition to the information on whether there is a T on the 8-inch line opposite to the point where we spoke of the possibility of a future riser at the end of a line to the west, I should like to know if you would want a flat-faced pulley to be furnished in addition to the sheaves for the V-belts. It occurred to me that this might be desirable, and if so, it would be necessary to know the diameter of the face width. This would be determined by the speed at which you would want to operate other machinery knowing that this motor would operate at about 1760 r.p.m.

It occurred to me after you had left that it might be a possibility that Mr. Smith had taken the profile along the ground as would be represented by the way the pipe would lay. Would you please make sure for me whether he used horizontal distances in each case between the stations. This is important only on the west side of that steep slope.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

WEC:1s
Mr. W. E. Code
Colorado State College of
Agriculture & Mechanical Arts
Fort Collins, Colorado

Dear Mr. Code:

I talked with Mr. Putnam concerning the respective power consumption of a three and five horse-power motor, and I found that unless we use these motors at the same time that the feed grinder motor is on there should be no increase in the demand for electricity on the campus. There would be some increase in the total consumption of power, but that is small as compared with the power used by the feed grinder. I don't believe we need be concerned about the power consumption of a five horse-power motor as compared with the three.

Very truly yours,

E. H. Bader
E. H. Bader, Acting Dean
Mr. W. E. Code  
Associate Irrigation Engineer  
Fort Collins, Colorado  

Dear Mr. Code:

In answer to your letter of April 30th I wish to state that I believe it will be as well for you not to include the flat-faced pulley in getting bids for the motor, since we do not now know what machines we may want to use this motor with. We can have these pulleys added at some later time. As far as we can remember there is no T in the 8-inch line wherever we thought there might have been one placed. We have not dug up the point of possible location, but I believe it will be well to consider that it was not installed. As I study the pump line to the campus I believe we had best include four risers and two T's in this line, distributed as follows: One T and riser east of the west campus road, one T and riser west of the east campus road, one riser east of the east campus road, and one riser in the center of the space between the east and west campus roads. I believe I suggested that we might want a riser inside of the fence west of the residences. On further study it will probably be as well to omit these accessories to the line.

I find in talking with Mr. Smith that in measuring the hillside distances he gave you the horizontal lengths. When you get bids for the pipe please include five hundred (500) feet of pipe for the south end of the campus along the football field. This should be six inches in diameter, would have three risers each thirty inches high, and two elbows, the angles of which will have to be determined as soon as we can make the survey.

We are having another nice snow storm which has put down a lot of moisture.

We were very sorry to hear of the passing of the President's nephew. He is certainly having his trials this spring.

Very truly yours,

E. H. Bader, Acting Dean

EHB/PT
May 18, 1935.

Mr. E. H. Bader,  
Acting Dean,  
Fort Lewis School,  
Hesperus, Colorado.

Dear Mr. Bader:

In order that the pipe line will not be delayed since we have already asked for bids on it, we should have the details of the South Side Extension. Would it not be possible for you to let me have these plans preferably sketched on a map of the campus which will show the stationing of the turns and the location of the risers.

We have not as yet selected the pump because of the delays in receiving bids. It is my hope to get to Denver Monday to interview a few of the bidders, and at that time decide which pump we want. By interviewing the state purchasing agent at the same time there should be little delay in getting the order through. I believe it best that you allow me to make this selection rather than to send you the various proposals in that I feel familiar with your desires.

Yours very truly,

W. E. Code,  
Associate Irrigation Engineer.

WEC:ls
May 16, 1935

MT. M. PEASANT
Active Men
Fort Lewis, Colo.

Dear Mr. Peasant:

In order that the pipe line will not be delayed since
we have already begun to pipe on it, we should have the
essentials of the South Side Extension work if not of
possible for you to let me have these plans immediately instead
of a map of the campus which will show the approximate
location of the lines. We have not as yet selected the bump because of the
feasibility of receiving pipe. It is my hope to go to Denver
weekend to interview a few of the physicians and at that time
reconsider the matter. My interest in the gun and have
some time since arrived to study
We shall see if present that
you the various propositions in that I feel familiar with
your pleasure.

Yours very truly,

W. E. Cope
Associate Extension Engineer

MWC}
Mr. W. E. Code  
Assistant Irrigation Engineer  
Fort Collins, Colorado

Dear Mr. Code:

Your letter of the 18th came yesterday and we have made some measurements and drawn a rather crude sketch to give you an idea of the proposed pipe line at the South end of the campus. I am not sure that you will be able to translate these figures but the dotted line labeled "proposed line" gives you the distances and locations of the pipe and risers. We have no map that we could use to sketch this line onto.

Under date of May 14th we have a copy of an order from the Purchasing Agent to the Martin Iron Works for seven (7) No. 6½ Type B Alfalfa Valves with bronze bolts. Since we have made no requisition for these valves I take it that you placed the order with the Purchasing Agent. If this is not the case please write me more at your earliest convenience so that we can head off the shipment if it should not be made. It is agreeable with us for you to make the selection of the pump, motor, and other equipment. We are glad to hear that you are progressing rapidly with these plans.

Very truly yours,

E. H. Bader, Acting Dean
July 16, 1935

Dean Bader
Fort Lewis School
Hesperus, Colorado

Dear Sir:

Enclosed is a marking and laying diagram which will help you in installing the pipe line ordered from this company.

The pieces will be marked as indicated by numbers in the circles on the diagram. We expect to make shipment in July 27, 1935.

Do not hesitate to call on us for any additional information you may require. We are sending a copy of this letter to Mr. W. E. Code at Fort Collins.

We trust that there will be no difficulty in the installation, as we have made every effort to insure that they connections will fit.

Thanking you for your excellent cooperation in this connection, we are

Very truly yours,

THE THOMPSON MANUFACTURING COMPANY

L.H. Height-H Engineering Department
July 18, 1935

State of Colorado
Purchasing Department
Denver, Colorado

Gentlemen: Attention: Mr. I. R. Taylor

Enclosed is the acknowledgment of our factory order No. 2463 which includes amended data sent us by Mr. W. E. Code after receipt of your purchase order No. 22,203, which was entered by us on our factory order No. 2268.

We are sending a copy of this letter to Mr. Code at Ft. Collins.

Will you please check our order No. 2463 with him and send us a purchase order for the items shown on the enclosed acknowledgement?

We shall be glad to give any further data which you may require if there is any question as to the correctness of the additional items.

Very truly yours,

THE THOMPSON MANUFACTURING COMPANY

L.H. Height-H
Engineering Department

Save with Steel
July 9, 1935

 Ft. Lewis School
 Hesperus, Colorado

 Gentlemen: Attn: Dean E. H. Bader

 Mr. Code has requested us to advise you as to when the 6" diameter pipe will be shipped.

 It has taken some little time to gather the necessary information for the fabrication of the pipe. However, we believe now that shipment will be made about July 17th which we trust will be satisfactory. The alfalfa valves and other fittings are now on hand and it is simply a matter of completing the necessary factory work on the pipe.

 We will advise you further as to the exact shipping date.

 Very truly yours,

 THE THOMPSON MANUFACTURING COMPANY

 N.J. Thompson-H
 Sales Manager

 Save with Steel
ACKNOWLEDGMENT OF ORDER
THE THOMPSON MANUFACTURING COMPANY
DENVER, COLORADO

Order No. 2268

Charge to: State of Colorado, Purchasing Dept.
Address: Denver, Colorado
Ship to: Fort Lewis School
Address: Hesperus, Colo.

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>DESCRIPTION</th>
<th>UNIT PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 16</td>
<td>1508 lin. ft. 16 ga. galv. and dipped riveted Toncan Iron pipe, slip joint, 6&quot; dia.</td>
<td>0.585</td>
<td>$882.18</td>
</tr>
<tr>
<td>2</td>
<td>increaser 8&quot; to 8&quot;</td>
<td>1.90</td>
<td>1.90</td>
</tr>
<tr>
<td>3</td>
<td>6&quot; riser, 15&quot; long, attached to Alfalfa valve.</td>
<td>3.75</td>
<td>3.75</td>
</tr>
<tr>
<td>4</td>
<td>6&quot; riser, 18&quot;</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>5</td>
<td>6&quot; riser, 12&quot;</td>
<td>3.75</td>
<td>7.50</td>
</tr>
<tr>
<td>6</td>
<td>6&quot; tees with 6&quot; blind flanges</td>
<td>4.45</td>
<td>8.90</td>
</tr>
<tr>
<td>7</td>
<td>4&quot; tee with nipple.</td>
<td>8.00</td>
<td>8.00</td>
</tr>
<tr>
<td>8</td>
<td>increaser 4&quot; - 6&quot;</td>
<td>1.62</td>
<td>3.24</td>
</tr>
<tr>
<td>13</td>
<td>6&quot; dia. 5 degree elbows</td>
<td>1.62</td>
<td>1.62</td>
</tr>
<tr>
<td>14</td>
<td>6&quot; 20&quot;</td>
<td>1.62</td>
<td>1.62</td>
</tr>
<tr>
<td>15</td>
<td>8&quot; channel as per drawing</td>
<td>1.90</td>
<td>1.90</td>
</tr>
<tr>
<td>17</td>
<td>6&quot; risers, 12&quot; long, attached to Alfalfa valve.</td>
<td>3.75</td>
<td>11.25</td>
</tr>
<tr>
<td>12</td>
<td>4&quot; gate valves (used)</td>
<td>11.75</td>
<td>23.50</td>
</tr>
<tr>
<td></td>
<td>sheets 16 ga. galv. Toncan - 16&quot; x 14&quot; to be held for Mr. W. E. Code.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No sales tax - purchased by State of Colorado

THIS IS NOT AN INVOICE

Your Valued Order has been entered in our Factory as stated above. If this is not in accordance with your understanding please notify us immediately. If we do not hear from you to the contrary your order will be filled exactly as here shown. We thank you for this business.

"IF THOMPSON MADE IT, IT IS MADE RIGHT"
July 6, 1935.

The Thompson Mfg. Co.,
3001 Larimer St.,
Denver, Colorado.

Attention: Mr. G. H. Garrett:

Dear Mr. Garrett:

I just received a letter from Dean E. H. Bader, Fort Lewis School, Hesperus, in which he reports that they expect to face a shortage of river water in the near future. He is anxious to know something about the time of delivery of the pipe. Would you be so kind as to write to him regarding this and send me a copy of the letter.

Yours very truly,

W. E. Code,
Associate irrigation Engineer.
Mr. W.E. Code
Experimental Station
Fort Collins, Colo.

Dear Mr. Code:

In spite of the fact that we have had an abundance of water all spring, we are now facing a shortage from the river and are very anxious to get our pumping system installed. Is there anything that may be done to hurry along the order for the pipe and other equipment?

Very truly yours,

E.H. Bader

E.H. Bader, Dean
June 25, 1935.

Thompson Manufacturing Co.,
3001 Larimer Street,
Denver, Colorado.

Attention: Mr. G. H. Garrett.

Dear Mr. Garrett:

Under separate cover I am sending the out of a section of well casing which you so kindly loaned me many months ago. Allow me to express my sincere thanks for the use of this cut. There has been a most exasperating delay in getting out this bulletin, and the cut was only recently released.

Under separate cover I am sending you a few copies of the bulletin and shall send more if you desire them.

I was about ready to give you the specifications on the 6-inch pipe for the south extension of the Fort Lewis irrigation system when I discovered that the memorandum from the Dean was incomplete. It will be necessary to delay them for a few days until the information is available.

I wish to call attention to a change in item 7 which was originally listed as a 4-inch T. Since the pump size is now known to be 4-inch, this T will be of that size with a 4-inch standard pipe nipple on the stem end. There will also be required a 3/4-inch waste nut and plug at the bottom of the pipe 4 feet from the T flange to the west. At a similar distance to the east from the other T flange there is to be a 1/2-inch waste nut and plug. Both of these are needed as drainouts.

A new item was added to your order which is intended for my work in setting a Parshall flume in the field. It consists of two 16-gage steel galvanized sheets 14 by 16 inches. On the short edge there is to be riveted a 2-inch by 10-inch strip which will be flush on one end so as to provide a reasonable surface for driving in soft dirt. The strip needs to be shorter than the width of the plate in order to fit into the front of the flume. These two plates are not to be shipped to Fort Lewis, but are to be held at your shop until
I have an opportunity to pick them up.

You shall hear from me again with additional information on the Fort Lewis pipe line.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
July 2, 1935.

Thompson Manufacturing Co.,
3001 Larimer St.,
Denver, Colorado.

Attention: Mr. G. H. Garrett.

Dear Mr. Garrett:

Allow me first to recall to your attention my letter of June 25 regarding certain features of the Fort Lewis pipe line.

I now have available the details for the south end extension. The accompanying sketch shows the old 8-inch line in full while the additions are in dotted lines. It will be necessary for you to provide the necessary connections to get from the 8-inch to the 6-inch. Two elbows will be needed as indicated and three risers 24 inches high. The 6½ inch Martin alfalfa valves are to be attached to the risers. At the end of the line there is to be a blind flange at the bottom of which there is to be a connection for a 1-inch valve for drainout purposes. You are to furnish the accessories for this drainout including the valve. I believe this valve should be either a globe or check valve rather than a stopcock, and since either one should be satisfactory, use the cheaper. I do not think that exact dimension lengths are required on these new lines hence you can make your pipe lengths practically standard throughout.

Dean Bader tells me that you furnished this old line, and if so you may have in your files the details such that you could tell just what sort of connections are at the points where it is intended to attach the new pipe. I had been my understanding that 8-inch Ts had been located at these points.

If it has not been mentioned before, the shipment of alfalfa valves from the Martin Iron Works was made to Hardesty, and it will be necessary for you to call for these valves at this company's place of business. There should be seven #6½ valves in their possession.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

enc.
July 20, 1935.

Dean E. H. Bader,
Fort Lewis School,
Hesperus, Colorado.

Dear Dean Bader:

A letter just received from Thompson states that they will make shipment of the pipe on July 27 which seems to be a long delay from their previous estimate of July 17.

I believe by this time we have straightened out the size of the tees already in place on the south line to which the new lines must be attached. I did not recall if you had told me what these sizes were and since changes were made from Mr. Parshall's original plans I was not sure, but I had assumed that the Thompson Manufacturing Company would have this information in their files. It appears that they had no drawings and did not know where the individual pieces, of which they did have a record, were to be installed.

I was a little too tardy in taking up the matter of advisability of a foot valve on the pump and omitting a check valve. Mr. Rihn did not pick me up on this until I mentioned it to them later. He advises a check valve in front of the pump and so I made this change in the order, and a 4-inch check valve is supposed to have been sent you on a separate shipment. You are to return the foot valve to Hendrie & Bolthoff for credit. It will be necessary with this set-up to purchase a priming pump which need be nothing more than a common pitcher pump. With the foot valve I had contemplated priming by pouring water into the pump, but this will not be possible now.

There will probably be other points about setting the pump which you will want to take up with me and do not hesitate to do so.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
May 6, 1935

Irrigation Investigations
Fort Collins, Colo.

Attention Mr. W. E. Code,
Associate Irrigation Engineer.

Gentlemen:

We are in receipt of your letter of recent date asking for quotation on 4 - 6½ Type B Alfalfa Valves and 2 - 8½ Type B Alfalfa Valves, f.o.b. Denver.

In answer we take pleasure in sending you one of No. 34-E Catalogues in which you will find the B Valves priced and illustrated on page 6.

From the prices as given in this catalogue we will be glad to allow you a discount of 40%, to which will have to be added the freight charges, which in this case amount to $2.38 for the valves referred to. We are quoting you in this way instead of giving an individual valve price as we are not certain whether you would want your valves with steel or bronze bolts, which makes a slight difference in the cost.

We also note in your letter that you state you are placing a small order through the State Purchasing Agent in Denver for 1 - 10 Type H Gate and 1 - 12 Type I Gate. We have not heard anything from the State Purchasing Agent about this and we are simply mentioning it so that if you are in a hurry you can jack them up and have them send their order forward.

Thanking you for your inquiry and hoping we will have the pleasure of furnishing you with some of our valves, we are

Yours very truly,

MARTIN IRON WORKS

GEO. C. MARTIN, PRESIDENT
GAYLORD J. MARTIN, VICE PRESIDENT
WILLIAM A. RICE, SECRETARY
E. T. ALDRIDGE, SUPERINTENDENT

ALL AGREEMENTS CONTINGENT UPON STRIKES, ACCIDENTS, OR OTHER CAUSES BEYOND OUR CONTROL

Dean E. H. Bader,
Fort Lewis School,
Hesperus, Colorado.

Dear Dean Bader:

To answer your question regarding the check valve in your letter of the 22nd, this check valve is required on the discharge side of the pump in order that the pump will not be subjected to the water hammer. If the foot valve alone were used, you can see that the pump itself would be under this excessive pressure, and Mr. Rihn thought that because of the long pipe line it would be much safer to place a check valve in the discharge line. The only reason we need checks of any sort is to keep the line full of water. It would be possible to prime the pump without either of the check or foot valve by closing the two gate valves installed in the main line. These two lines, by the way, are a part of the Thompson shipment and should arrive with the pipe.

I feel that the foot valve is an unnecessary piece of equipment as long as the check valve is in and priming can be done by means of a pitcher pump.

It may be advisable to increase the size of the pump house about 6 or 8 inches in order that there will be room for the manipulation of bolts on the inside of the foundation.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.

WEC:1s
Mr. W. E. Code  
Associate Irrigation Engineer  
Colorado Experiment Station  
Fort Collins, Colorado  

Dear Mr. Code:  

Your letter of July 20 arrived this morning. We are not quite clear as to the reason for not using the foot valve. Is the check valve which has been delivered to be used in its place? Did you arrange for four-inch gate valves to be used on the lines from the pump?  

We are presuming that these have been ordered and are to be shipped with the pipe, but since some of the other equipment has already been delivered and the valves are not here, we have been wondering if the order has been placed for them.  

We appreciate the interest you have taken in these matters and are sorry that we did not understand your telegram the other day when you wired about the size of the tees. We regret that the order has been further delayed in shipment as our water supply is quite short and we are in need of this pumping plant.  

With good wishes, I am  

Very truly yours,  

E. H. Bader, Dean  

EHB:PEP
August 6, 1935.

Dean E. H. Bader,
Fort Lewis School,
Hesperus, Colorado.

Dear Dean Bader:

Regarding your letter of the second, I am at a loss to know why the hydrant does not fit the new valves. I made it a point to read the marking on the old valves and was certain that they were No. 61/2 Type B. This is the type ordered for the new work, and the only suggestion that I can make is to compare the marks on these two valves. If the new ones are different it will be necessary to order special hydrants for them.

In your letter you mention "Q arches", a term with which I am not familiar, and I wonder if you have in mind "Q valves" as there is a valve of this type. The catalog states that the hydrant will fit either Type B or Q valves.

I hope that you will be able to assemble all of this equipment in such a manner so that you will be delayed no longer than is necessary to put the pipe in.

Yours very truly,

W. E. Code,
Associate Irrigation Engineer.
THE FORT LEWIS SCHOOL
OF
THE COLORADO AGRICULTURAL COLLEGE

HESPERUS, COLORADO

August 2, 1935

Mr. W. E. Code
Associate Irrigation Engineer
Irrigation Investigations
Fort Collins, Colorado

Dear Mr. Code:

We have unloaded the pipe today and discovered that the KT portable six and one half inch hydrants will not work on the arches that were sent with the valves which have been attached to these pipes. The alfalfa B valves are all right but it is apparent that somewhere along the line we neglected to specify Q arches. It will be necessary to get at least one new hydrant if we are to use the valves and arches which were supplied with this pipe. What are your suggestions?

Very truly yours,

E. H. Bader

E. H. Bader, Dean

ERB:PEP
July 31, 1935

Mr. W. E. Code
Associate Irrigation Engineer
Colorado Experiment Station
Fort Collins, Colorado

Dear Mr. Code:

Your letter of July 27th came yesterday and we appreciate the information contained. The State Board is meeting today and needless to say, we have been very busy making preparations to entertain them. Tomorrow is the annual Visitors' Day which has also made a great deal of work. Generally, the activities have been progressing satisfactorily.

The pipe has not arrived, but we hope that it will soon for we are needing this supplementary water supply.

With good wishes, I am

Very truly yours,

E. H. Bader, Dean

E. H. Bader, Dean
TO: Director Homer J. Henney
FROM: W. E. Code and O. J. Trenary

SUBJECT: Report of inspection of Ft. Lewis A & M water supply for domestic and irrigation use.

REMARKS: At your request we visited the above school on November 8, 1950. We were shown most of the essential features and otherwise greatly helped by R. H. Isaacson, Farm Manager; R. H. Colley, Business Manager and Joe Nelson, Plumber. The latter was the only one who had been on the campus for more than one year.

We first visited Lory Spring where recent work had been done by blasting to increase the flow. We then visited the reservoirs north of the campus and were shown the conditions to the south, including the reservoir on Hay Gulch.

The problem as presented to us was the development of a safe and adequate supply of water for the campus and if possible, increase the supply now available for the irrigation needs of 20 acres of experimental plots and 20 acres of pasture. Two previous reports have been made on this subject, one by Sharp and Stevens under the direction of H. R. Wanless, geologists in 1950 and the other by Phillips, Carter and Osborne, Inc. engineers, dated December 1949. They will be referred to hereafter as geologic and engineering reports.

The main water supply for the institution is derived from Hay Gulch Ditch. A second source is Ammons Ditch which is far less valuable. The third important source is from Lory Spring. There are several minor outcrops of water along the base of the first terrace on which Lory Spring is located and at the base of the second terrace. A swampy area exists on the bottom lands for some distance north from the north edge of the campus. Water from this area and Lory Spring is picked up by a pump and used for campus irrigation and also to supply the experimental plots below on the first terrace. This pump was installed in 1935. During wet seasons and the peak of irrigation, this swampy area increased in size and reaches around and into the dooryards of the northernmost dwelling units.
Surface Water Supply

Hay Gulch Ditch operates under priorities 3 and 5 from the La Plata River. The school receives 2 5/8 second-feet under the full appropriation of number 3 and 2 second-feet from number 5. Ammons Ditch provides a maximum of 6 second-feet but since it has a very late priority it is in operation but a very short time during the flood flow. In a normal year, only priority number 3 provides water after July 1 and then usually less than the full appropriation. An agreement exists under the Compact between Colorado and New Mexico whereby when the river flow reaches a certain low point, all the water is used by each state during alternate 10-day periods. This year being an extremely dry one, water had to be borrowed from other users of Hay Gulch Ditch water. The flow at present is on the order of 1/2 second-foot.

The domestic supply for the school comes from a reservoir supplied by diversions from Hay Gulch Ditch. Its maximum capacity is reported as 11,000,000 gallons or 33 acre-feet. A manually operated chlorination plant is located at the inlet and the water is treated before going into this open reservoir. Tests of water samples taken from the reservoir and from faucets on the campus have consistently shown E Coli contamination. It has been usual to empty this reservoir once a year to kill the aquatic growth which gives the water an unsatisfactory flavor. To provide storage during such operations, a second smaller reservoir known as number 2 reservoir was constructed alongside of it. One bank is common to both. It was not determined how long or how much this plan had been in operation. This year because of the meager water supply, water was diverted around the reservoirs in a ditch and taken into the pipe line opened for the purpose. This was a dangerous measure and an accident resulted in muddy, trashy water entering the system. Number 2 reservoir is reported as having a capacity of about 6 acre-feet and very leaky. Number 1 reservoir is considered satisfactorily tight.

Winter operation of the reservoir is reported as unsatisfactory. Water freezes in the inlet ditch and flows out on top of ice already formed. Shortages have been experienced because of such conditions and in addition, the chloridation

-2-
system cannot function properly.

The functioning of this system was considered unsatisfactory and dangerous in the engineering report. We concur in this opinion. The principal change proposed in their report was that of installing a treatment plant, automatically operated, below the reservoir. We propose to meet the situation in a different manner as outlined under Recommendations.

Lory Spring

Lory Spring is the most important of a number of seepage outcrops near the campus. It rises in a slight depression above the foot of the first terrace. It is about 2,650 feet from and 50 feet higher than the ground surface at the Administration building. The pipe line from the reservoir passes within a few feet of it. The water is of good quality, being practically the same in mineral content as the present surface supply (tests in 1946 by J. W. Tobiska). Flow from this spring joins water outcropping in the swampy area before mentioned.

A 3-inch Parshall flume was installed this fall below the spring and the flow determined as 72 gallons per minute. This was believed to be a minimum because of the past extremely dry season and the usual low flow period. A trench about 150 feet long and from 2 to 3 feet deep was blasted out with dynamite and following this the flow increased to 98 g.p.m. The trench was then extended upstream about 75 feet by a second blast and the flow was further increased to 117 g.p.m. (168,000 gallons per day) which was the flow November 8.

It is believed that an aquifer, perhaps a thin gravel stratum exists below the surface at a shallow depth; that it is under sufficient pressure to force a discharge upward at weak points in an otherwise highly impervious earth mantle. Lory Spring represents such a weak spot in the earth mantle. If this surmise is not correct, a second guess is that the aquifer may be an outcrop of the Cliff House sandstone mentioned in the geologic report.
Since water continued to flow into the trench from points only a few feet from its edge and at an elevation 2 feet or so higher than the water surface in the trench, it would appear that the pressure had not been relieved to any great extent by the trenching. The inference is that deepening the trench would further increase the flow. There is evidence also that lengthening the trench would bring in additional flow. If the source of water in the swampy area is the same as Lory Spring, it is possible that the water yield from the swamp would diminish somewhat.

**Ground Water**

The geologic report indicates that probably a good water supply could be obtained from a well drilled into the Pt. Lookout sandstone at a depth of between 600 and 650 feet. No chemical analysis of water from this source is available but one driller reported it as good. A less permeable formation, the Cliff House sandstone would be encountered at a depth of between 300 and 350 feet near the Campus and should contain water of good quality. The quantity obtainable from these sources remains in doubt. The geologists estimate the depth of the alluvial deposits along the river or on the next higher terrace as being 15 or 20 feet. This seems to correspond with an opinion gained 15 years ago by Code in conferring with Dr. Chas. A. Lory and Dean E. H. Bader. The yield of a well dug in this material containing many large cobbles would probably be low – at least uncertain. The geologists believed that the least expensive source of water would be from Lory Spring and another near the experimental plots.

**Water Requirements**

The engineering report contains an estimate based on data furnished by Mr. Nelson of a winter use of 64,600 gallons per day. At that time there were about 100 permanent residents and 125 students on the campus. There has been little change in the population since that date. The additional information gained is
that some 50 head of horses and cattle use water from the domestic system. The quantity mentioned represents a use equivalent to 290 gallons per day per person. This appears to us as high for only domestic and sanitary use. The use by stock should not exceed 1500 g.p.d. The report states further that the summer use is about 324,000 g.p.d. equivalent to a continuous flow of 225 g.p.m. The irrigation use then would be 259,100 g.p.d.

It is believed that the estimates of use of water on the campus used by the engineers are excessive. We propose an estimate of 150 gallons per day per person for culinary and sanitary uses. This is considerably higher than municipal and farmstead use. The quantity required then for that use would be 34,000 g.p.d. equivalent to a flow of about 24 g.p.m. We were provided with an estimate of 6 acres of grass and gardens irrigated from the pressure system. For field crops, a flow of 10 g.p.m. per acre is considered generous. Assuming this rate be doubled to 20 g.p.m. per acre, the total irrigation use would be 172,000 g.p.d. The total use then becomes 34,000 plus 1,500 plus 172,000 or about 208,000 g.p.d. This is equivalent to a flow of 145 g.p.m.

Should all the irrigating be done in a 12 hour day the maximum demand for this purpose would be 240 g.p.m. The peak demand for domestic water may be 4 times the average use and if we assume this to be 100 g.p.m., the over-all peak would be about 340 g.p.m. Another type of peak would occur in case of fire. It is presumed here that 3 fire streams of 175 g.p.m. might be wanted. Such a stream would be provided with a pressure of 50 pounds at a hydrant, 150 feet of 2½-inch hose and a 1-inch nozzle. A total flow of 525 g.p.m. would be required for this purpose. In such an emergency all other unnecessary use would be cut off and a total flow of 550 g.p.m. could be considered the peak demand. If the peak demand on the facilities for fire fighting be met, then the ordinary peak demand will be met automatically.

The probability of the school attendance growing materially is remote. The highest ever reached was 235 in 1946 which was due to the Veterans Training Program. The high previous to that year since its establishment in 1927 was 126.
Thus its history shows no trend toward increasing enrollment. It is believed that the water requirements here assumed are sufficiently elastic and the quantities mentioned in (2) under Recommendations, sufficiently ample that there is no need at present to provide for increased use.

The theoretical capacity of the present pipe line is in doubt. The sizes and quantities given us by Mr. Nelson do not agree with those shown in the engineering report. Also the lengths given in the report do not agree with their vicinity map. To facilitate explanations a rough sketch of locations accompanies this report. Referring to that sketch we were told that the main transmission line consisted of 1,000 feet of 8-inch transite pipe from A to B, 4,600 feet of 6-inch transite from B to D and 1,700 feet of 6-inch cast iron pipe from D to E. The difference in elevation between A and B is about 135 feet equivalent to 80 pounds static pressure. To maintain an operating pressure of 50 pounds, 30 pounds could be used up in friction. This would be used up with a flow of about 375 g.p.m. If all the transite pipe were 8-inch as shown by the report the capacity would be about 525 g.p.m.
Recommendations

1. That further exploratory development work be done immediately at Lory Spring. This development to consist of deepening the existing trench an additional 3 or 4 feet with a drag line. A hole 5 or 6 feet deep should be dug initially to uncover if possible, a gravel aquifer. The remainder of the trenching be governed by these findings. The flow then should be measured. It is anticipated that Lory Spring when fully developed will supply the needs of the institution as now supplied and it is recommended that plans to that end be perfected. A collecting pipe is to be buried in the trench and surrounded with clean gravel then backfilled. A concrete well to serve as a pump pit is to be built at the lower end. The capacity of the pump should be about 160 g.p.m. (230,000 g.p.d.) or a little less than the base flow of the spring. It will be necessary to provide a pump and an elevated tank of about 50,000 gallons capacity. In event of a breakdown of equipment this would provide water on a restricted use basis for at least 3 days. It would provide water at the peak rate of demand for fire fighting for about 2 hours. Using the pipe sizes given us, there would be 1,000 feet of 8-inch and 1,600 feet of 6-inch transite pipe involved. The friction loss in this distance when carrying 550 g.p.m. would be 40 feet. Therefore to provide a residual pressure of 50 pounds at the end of the line, the water surface in the tank would have to be 105 feet above Lory Spring elevation. This height could be reduced 10 or 15 feet by placing the tank on higher ground nearby. If 8-inch pipe were used the full distance the friction loss would reduce to 14 feet which would reduce the required tank height 26 feet.

2. There is a good possibility that the water from Lory Spring will not have to be treated with chlorine. However provision should be made for the installation of such equipment. Since the water should be treated before going into the tank, a complicated apparatus is not indicated as the flow to be treated will be constant.
1. Assuming the plan under (2) is followed, the pipe line from the reservoir to Lory Spring would be about 600 g.p.m. which could be diverted into the ditch serving the experimental plots.

5. It is recommended that reservoir capacity be increased as much as is feasibly possible. The limit is probably fixed by the inlet conditions. This can be effected by raising the banks on the south and west sides as suggested in the 1949 engineering report. It is there estimated that an additional 12 acre-feet could be stored by raising the water surface 3 feet. The estimated cost was $500 but we believe that it would cost probably double that. All this water would be used for field irrigation and would permit some additional land to be brought under cultivation.

   Permission from the State Engineer would probably have to be obtained to make these changes.

6. It is suggested that for the present at least, plans for treating the smaller reservoir with Bentonite to correct leakage be set aside. It appears cheaper to gain additional storage to follow the plan in (5).

7. Since the flow from Lory Spring will be cut off from the irrigation supply, it is suggested that some thought be given to increasing the flow from the swampy area that furnishes part of the water to the irrigation pump near the northwest corner of the campus. Some ditching may be necessary. By making some changes at the pumping plant it would be possible to augment the seep flow from the ditch through the west branch of the pipe line. There is also a possibility of transferring about 300 g.p.m from the ditch to the campus system through the pipe line by gravity. This operation would result in the seep stream being wasted past the pump.

8. In the event of needed expansion it might be well to draw attention to the possibility of capturing 10 to 20 g.p.m from a seep outcrop at the base of the second terrace not too far from Lory Spring.

10. It is recommended that engineers be employed to draw plans, write specifications and make estimates for the facilities mentioned herein.
SKETCH MAP
Ft. Lewis A&M College
approx. scale 1" = 1000'

Hay Gulch Ditch
Ammons Ditch
Chlorination plant
Reservoirs

El. top on box 77727

C. Lory Spring
El. 7660

La Plata River

Campus
2 Admin. Bldg.
El. 7610
To: Director Homer J. Henney

From: W. E. Code and O. J. Trenary

Subject: Report of inspection of Ft. Lewis A & M Water supply for domestic and irrigation use.

November 17, 1950

At your request we visited the above school on November 8, 1950. We were shown most of the essential features and otherwise greatly helped by R. H. Isaacson, Farm Manager; R. H. Colley, Business Manager and Joe Nelson, Plumber. The latter was the only one who had been on the campus for more than one year.

We first visited Lory Spring where recent work had been done by blasting to increase the flow. We then visited the reservoirs north of the campus and were shown the conditions to the south, including the reservoir on Hay Gulch.

The problem as presented to us was the development of a safe and adequate supply of water for the campus and if possible, increase the supply now available for the irrigation needs of 20 acres of experimental plots and 20 acres of pasture.

Two previous reports have been made on this subject, one by Sharpe and Stevens under the direction of H. R. Wanless, geologists, in 1950 and the other by Phillips, Carter and Osborne, Inc. engineers, dated December 1949. They will be referred to hereafter as geologic and engineering reports.

The main water supply for the institution is derived from Hay Gulch Ditch. A second source is Ammons Ditch which is far less valuable. The third important source is from Lory Spring. There are several minor outcrops of water along the base of the first terrace on which Lory Spring is located and at the base of the second terrace. A swampy area exists on the bottom lands for some distance north from the north edge of the campus. Water from this area and Lory Spring is picked up by a pump and used for campus irrigation and also to supply the experimental plots below on the first terrace. This pump was installed in 1935. During wet seasons and the peak of irrigation, this swampy area increases in size and reaches around and into the dooryards of the northernmost dwelling units.
Surface Water Supply

Hay Gulch Ditch operates under priorities 3 and 5 from the La Plata River. The school receives 2 5/8 second-feet under the full appropriation of number 3 and 2 second-feet from number 5. Ammons Ditch provides a maximum of 6 second-feet but since it has a very late priority it is in operation but a very short time during the flood flow. In a normal year, only priority number 3 provides water after July 1 and then usually less than the full appropriation. An agreement exists under the Compact between Colorado and New Mexico whereby when the river flow reaches a certain low point, all the water is used by each state during alternate 10-day periods. This year being an extremely dry one, water had to be borrowed from other users of Hay Gulch Ditch water. The flow at present is on the order of \( \frac{1}{3} \) second-foot.

The domestic supply for the school comes from a reservoir supplied by diversions from Hay Gulch Ditch. Its maximum capacity is reported as 11,000,000 gallons or, 43 acre-feet. A manually operated chlorination plant is located at the inlet and the water is treated before going into this open reservoir. Tests of water samples taken from the reservoir and from faucets on the campus have consistently shown E Coli contamination. It has been usual to empty this reservoir once a year to kill the aquatic growth which gives the water an unsatisfactory flavor.

To provide storage during such operations, a second smaller reservoir known as number 2 reservoir was constructed alongside of it. One bank is common to both. It was not determined how long or how much this plan had been in operation. This year because of the meager water supply, water was diverted around the reservoirs in a ditch and taken into the pipe line opened for the purpose. This decidedly was a dangerous measure and an accident resulted in muddy, trashy water entering the system. Number 2 reservoir is reported as having a capacity of about 6 acre-feet and very leaky. Number 1 reservoir is considered satisfactorily tight.

Winter operation of the reservoir is reported as unsatisfactory. Water freezes in the inlet ditch and flows out on top of ice already formed. Shortages have been experienced because of such conditions and in addition, the chlorination...
system cannot function properly.

The functioning of this system was considered unsatisfactory and dangerous in the engineering report. We concur in this opinion. The principal change proposed in their report was that of installing a treatment plant, automatically operated, below the reservoir. We propose to meet the situation in a different manner as outlined under Recommendations.

Lory Spring

Lory Spring is the most important of a number of seepage outcrops near the campus. It rises in a slight depression above the foot of the first terrace. It is about 2,650 feet from and 50 feet higher than the ground surface at the Administration building. The pipe line from the reservoir passes within a few feet of it. The water is of good quality, being practically the same in mineral content as the present surface supply (tests in 1946 by J. W. Tobiska). Flow from this spring joins water outcropping in the swampy area before mentioned.

A 3-inch Parshall flume was installed this fall below the spring and the flow determined as 72 gallons per minute. This was believed to be a minimum because of the past extremely dry season and the usual low flow period. A trench about 150 feet long and from 2 to 3 feet deep was blasted out with dynamite and following this the flow increased to 98 g.p.m. The trench was then extended upstream about 75 feet by a second blast and the flow was further increased to 117 g.p.m. (168,000 gallons per day) which was the flow November 8.

It is believed that an aquifer, perhaps a thin gravel stratum exists below the surface at a shallow depth; that it is under sufficient pressure to force a discharge upward at weak points in an otherwise highly impervious earth mantle. Lory Spring represents such a weak spot in the earth mantle. If this surmise is not correct, a second guess is that the aquifer may be an outcrop of the Cliff House sandstone mentioned in the geologic report.
Since water continued to flow into the trench from points only a few feet from its edge and at an elevation 2 feet or so higher than the water surface in the trench, it would appear that the pressure had not been relieved to any great extent by the trenching. The inference is that deepening the trench would further increase the flow. There is evidence also that lengthening the trench would bring in additional flow. If the source of water in the swampy area is the same as Lory Spring, it is possible that the water yield from the swamp would diminish somewhat.

Ground Water

The geologic report indicates that probably a good water supply could be obtained from a well drilled into the Pt. Lookout sandstone at a depth of between 600 and 650 feet. No chemical analysis of water from this source is available but one driller reported it as good. A less permeable formation, the Cliff House sandstone would be encountered at a depth of between 300 and 350 feet near the Campus and should contain water of good quality. The quantity obtainable from these sources remains in doubt. The geologists estimate the depth of the alluvial deposits along the river or on the next higher terrace as being 15 or 20 feet. This seems to correspond with an opinion gained 15 years ago by Code in conferring with Dr. Chas. A. Lory and Dean E. H. Bader. The yield of a well dug in this material containing many large cobbles would probably be low - at least uncertain. The geologists believed that the least expensive source of water would be from Lory Spring and another near the experimental plots.

Water Requirements

The engineering report contains an estimate based on data furnished by Mr. Nelson of a winter use of 64,600 gallons per day. At that time there were about 100 permanent residents and 125 students on the campus. There has been little change in the population since that date. The additional information gained is
that some 50 head of horses and cattle use water from the domestic system. The quantity mentioned represents a use equivalent to 290 gallons per day per person. This appears to us as high for only domestic and sanitary use. The use by stock should not exceed 1500 g.p.d. The report states further that the summer use is about 324,000 g.p.d. equivalent to a continuous flow of 225 g.p.m. The irrigation use then would be 259,400 g.p.d.

It is believed that the estimates of use of water on the campus used by the engineers are excessive. We propose an estimate of 150 gallons per day per person for culinary and sanitary uses. This is considerably higher than municipal and farmstead use. The quantity required then for that use would be 34,000 g.p.d., equivalent to a flow of about 243 g.p.m. We were provided with an estimate of 6 acres of grass and gardens irrigated from the pressure system. For field crops, a flow of 10 g.p.m. per acre is considered generous. Assuming this rate be doubled to 20 g.p.m. per acre the total irrigation use would be 172,000 g.p.d. The total use then becomes 34,000 plus 1,500 plus 172,000 or about 208,000 g.p.d. This is equivalent to a flow of 115 g.p.m.

Should all the irrigating be done in a 12 hour day the maximum demand for this purpose would be 240 g.p.m. The peak demand for domestic water may be 4 times the average use and if we assume this to be 100 g.p.m., the over-all peak would be about 340 g.p.m. Another type of peak would occur in case of fire. It is presumed here that 3 fire streams of 175 g.p.m. might be wanted. Such a stream would be provided with a pressure of 50 pounds at a hydrant, 150 feet of 2½-inch hose and a 1-inch nozzle. A total flow of 525 g.p.m. would be required for this purpose. In such an emergency all other unnecessary use would be cut off and a total flow of 550 g.p.m. could be considered the peak demand. If the peak demand on the facilities for fire fighting be met, then the ordinary peak demand will be met automatically.

The probability of the school attendance growing materially is remote. The highest ever reached was 235 in 1946 which was due to the Veterans Training Program. The high previous to that year since its establishment in 1927 was 126.
Thus its history shows no trend toward increasing enrollment. It is believed that the water requirements here assumed are sufficiently elastic and the quantities mentioned in (2) under Recommendations, sufficiently ample that there is no need at present to provide for increased use.

The theoretical capacity of the present pipe line is in doubt. The sizes and quantities given us by Mr. Nelson do not agree with those shown in the engineering report. Also the lengths given in the report do not agree with their vicinity map. To facilitate explanations a rough sketch of locations accompanies this report. Referring to that sketch we were told that the main transmission line consisted of 1,000 feet of 8-inch transite pipe from A to B, 4,600 feet of 6-inch transite from B to D and 1,700 feet of 6-inch cast iron pipe from D to E. The difference in elevation between A and B is about 185 feet equivalent to 80 pounds static pressure. To maintain an operating pressure of 50 pounds, 30 pounds could be used up in friction. This would be used up with a flow of about 375 g.p.m. If all the transite pipe were 8-inch as shown by the report the capacity would be about 525 g.p.m.
Recommendations

1. That further exploratory development work be done immediately at Lory Spring. This development to consist of deepening the existing trench an additional 3 or 4 feet with a drag line. A hole 5 or 6 feet deep should be dug initially to uncover if possible, a gravel aquifer. The remainder of the trenching to be governed by these findings. The flow then should be measured. It is anticipated that Lory Spring when fully developed will supply the needs of the institution as now supplied and it is recommended that plans to that end be perfected. A collecting pipe is to be buried in the trench and surrounded with clean gravel then backfilled. A concrete well to serve as a pump pit is to be built at the lower end. The capacity of the pump should be about 160 g.p.m. (230,000 g.p.d.) or a little less than the base flow of the spring. It will be necessary to provide a pump and an elevated tank of about 50,000 gallons capacity. In event of a breakdown of equipment this would provide water on a restricted use basis for at least 3 days. It would provide water at the peak rate of demand for fire fighting for about 2 hours. Using the pipe sizes given us, there would be 1,000 feet of 8-inch and 1,600 feet of 6-inch transite pipe involved. The friction loss in this distance when carrying 550 g.p.m. would be 40 feet. Therefore to provide a residual pressure of 50 pounds at the end of the line, the water surface in the tank would have to be 105 feet above Lory Spring elevation. This height could be reduced 10 or 15 feet by placing the tank on higher ground nearby. If 8-inch pipe were used the full distance the friction loss would reduce to 14 feet which would reduce the required tank height 26 feet.

2. There is a good possibility that the water from Lory Spring will not have to be treated with chlorine. However provision should be made for the installation of such equipment. Since the water should be treated before going into the tank, a complicated apparatus is not indicated as the flow to be treated will be constant.
4. Assuming the plan under (2) is followed, the pipe line from the reservoir to
interrupted and used only for irrigation. The free discharge of Lory Spring would be
Lory Spring would be about 600 g.p.m. which could be diverted into the ditch
serving the experimental plots.

5. It is recommended that reservoir capacity be increased as much as is feasibly
possible. The limit is probably fixed by the inlet conditions. This can be
effected by raising the banks on the south and west sides as suggested in
the 1949 engineering report. It is there estimated that an additional 12
acre-feet could be stored by raising the water surface 3 feet. The estimated
cost was $500 but we believe that it would cost probably double that. All
this water would be used for field irrigation and would permit some additional
land to be brought under cultivation.

Permission from the State Engineer would probably have to be obtained
to make these changes.

6. It is suggested that for the present at least, plans for treating the smaller
reservoir with Bentonite to correct leakage be set aside. It appears
cheaper to gain additional storage to follow the plan in (5).

7. Since the flow from Lory Spring will be cut off from the irrigation supply,
it is suggested that some thought be given to increasing the flow from the
swampy area that furnishes part of the water to the irrigation pump near the
northwest corner of the campus. Some ditching may be necessary. By making
some changes at the pumping plant it would be possible to augment the seep
flow from the ditch through the west branch of the pipe line. There is also
a possibility of transferring about 300 g.p.m from the ditch to the campus
system through the pipe line by gravity. This operation would result in
the seep stream being wasted past the pump.

8. In the event of needed expansion it might be well to draw attention to the
possibility of capturing 10 to 20 g.p.m from a seep outcrop at the base of the
second terrace not too far from Lory Spring.

10. It is recommended that engineers be employed to draw plans, write specifications
and make estimates for the facilities mentioned herein.
SKETCH MAP
Ft. Lewis A + M College
approx. scale 1"=1000'

- Hay Gulch Ditch
- Ammons Ditch
- Chlorination plant
- Reservoirs
- El. top or box 77927
- Ditch pipe
- 6" Ditch pipe
- River
- C. Lory Spring
  El. 7660
- La Plata
- 4' Transite pipe
- 6' Transite pipe
- Comp A
- Adm. Bldg.
  El. 7610
SKETCH MAP
Ft. Lewis A&M College
approx. Scale 1" = 1000'

Hay Gulch Ditch
Ammons Ditch
Chlorination plant
Reservoirs
El. top of box 77927

N

La Plata
River

C = Lary Spring
El. 7660

D = 6" C.I. Pipe

La Plata Pipe

Comp. A
B. Adm. Bldg.
El. 7610

D = Transite

Reservoirs

N
SKETCH MAP
Ft. Lewis A + M College
approx. scale 1"=1000'

- Hay Gulch Ditch
- Ammons Ditch
- Chlorination plant
- Reservoirs
- El. top of box 77927
- C: Lory Spring
- E1: 7660
- La Plata River
- Camp B Transect
- B: Adm. Bldg. E1: 7610