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Multi-Purpose Power Unit with Horizontal Water
Turbine: Operation and Maintenance Manual

by Andreas Bachmann and A.M. Nakarmi

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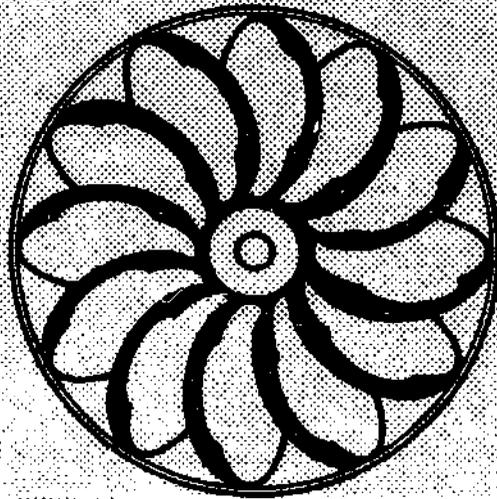
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MPPU

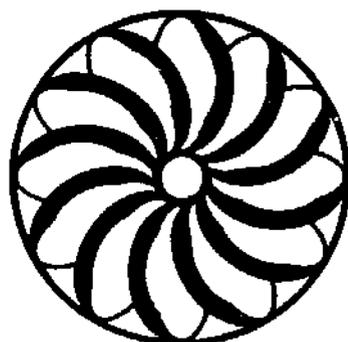
MULTI-PURPOSE POWER-UNIT
WITH HORIZONTAL WATER TURBINE



MANUAL OPERATION AND MAINTENANCE

A.-M. NAKARMI
A. BACHMANN

M P P U
MULTI-PURPOSE POWER-UNIT
WITH HORIZONTAL WATER TURBINE



VOLUME : II

MANUAL
OPERATION AND MAINTENANCE

-M P P U-
-RICE HULLER-
-OIL EXPPELLER-
-SMALL DYNAMO-

AKKAL MAN NAKARMI AND ANDREAS BACHMANN

KATHMANDU

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FOREWORD

The utilization of small hydro resources in Nepal has gained in popularity with the upgrading of traditional water wheels. Now farmers can mill more efficiently or operate small rice hullers or other small machines from the power generated by such mini hydro turbines.

We have been searching for information on these additional small machines, with little success however. Therefore we have been limited in our collection of materials to our own experiences at various mill sites.

There is no claim that these pages are a complete collection of all the necessary information on mini hydro turbines and on the small additional machines. We would welcome suggestions, and would try to incorporate such additional information into another issue to come.

The authors

OPERATION OF MPPU
AND SMALL AGRO-PROCESSING MACHINES

Experience will teach you many things concerning the actual work of the machines which cannot be dealt with in a printed booklet of instructions!

CAUTION:

- Mobil oil and bearing greasing are significantly dangerous to the health. It does not only cause stomach problems, but can even paralyse persons for life!

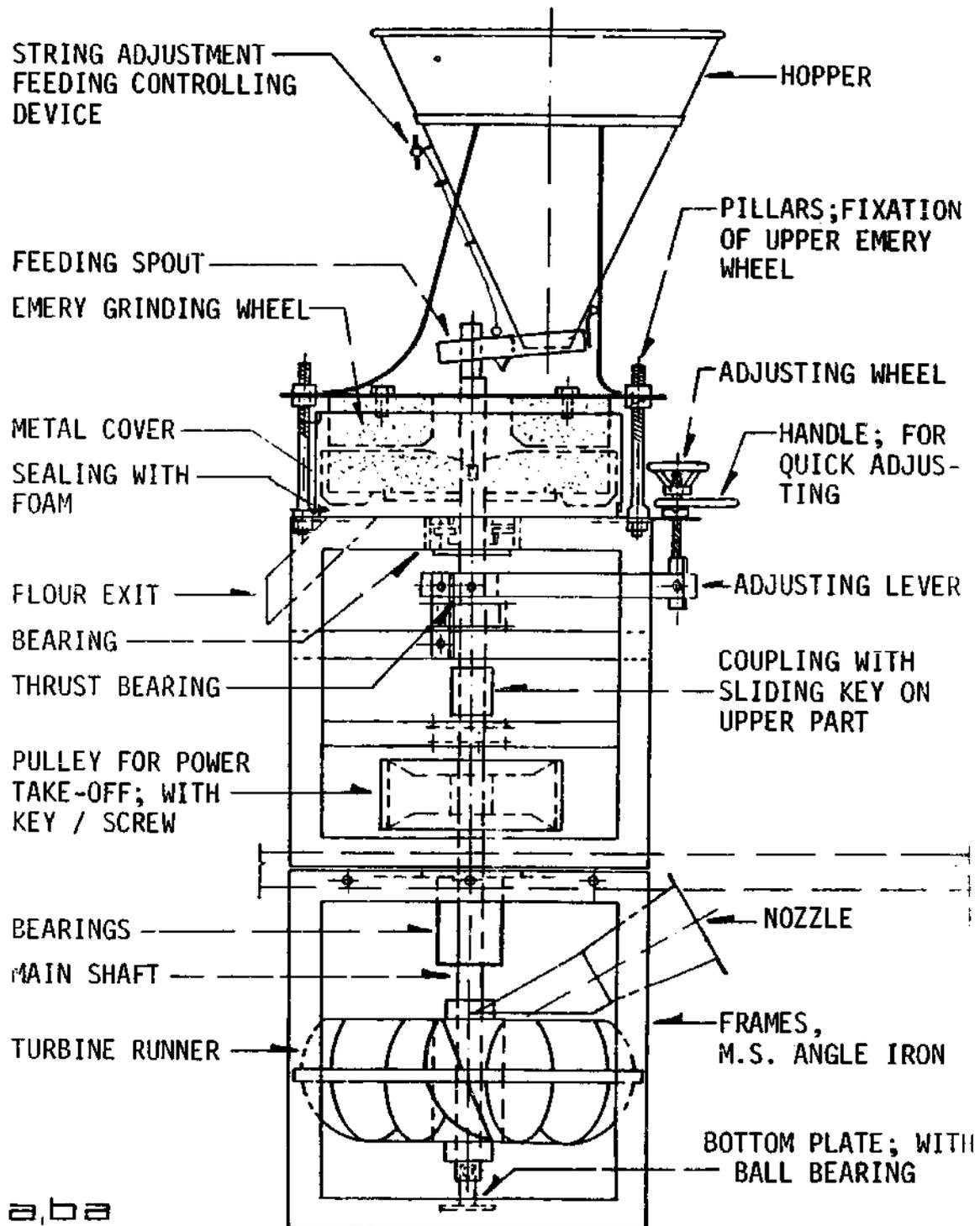
- Never mix Mobil oil with plant (edible) oil, and make sure that Mobil oil does not come into contact with food (oil cakes, water, etc.) Don't use containers for Mobil oil, which could be taken by mistake for edible oil!

- Do not use hammers directly on any machines or parts of them. If knocking is required, place a piece of wood against the machine part and knock that with the hammer.

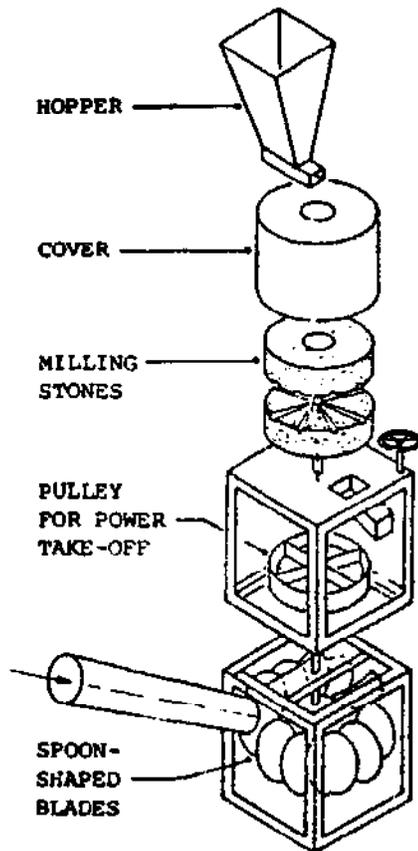
- Never run machines without greasing (or oiling). If run without proper greasing, a machine can be damaged within a very short period - even in a few minutes!

- Never run machines with defective bearings or bushes: this can damage the entire system!

MULTI - PURPOSE POWER - UNIT



MPPU CONCEPT



The MPPU is a concept to improve existing traditional mills, as well as to bring new, small scale water power application to the reach of rural people, even to very remote areas.

The installation can be as per traditional set-up; with the same head and same water quantity, it can grind 4 - 8 times more over traditional water mills.

The MPPU can be used as a complete set: turbine, mill and power take-off, and also with its separate pieces;

- turbine only (e.g. small dynamo)
- mill only (to be run by conventional motors; by animal or wind power)

Depending on Head and water quantity the power output can range from 2-5, 10, 15 H.P., and machines can easily be fitted, such as rice huller, oil expeller, dynamo (12V, DC or 220V AC). The small scale cottage industry can run wood saw, planer, looms, etc.

Some Datas:

Weight: appr. 375 kg
Height: total 210 cm
Surface Area: appr. 75 cm²
 of mill only

Power Transformation:

Depending on head and water quantity: 2.5-5 H.P. turbine can produce 10 HP

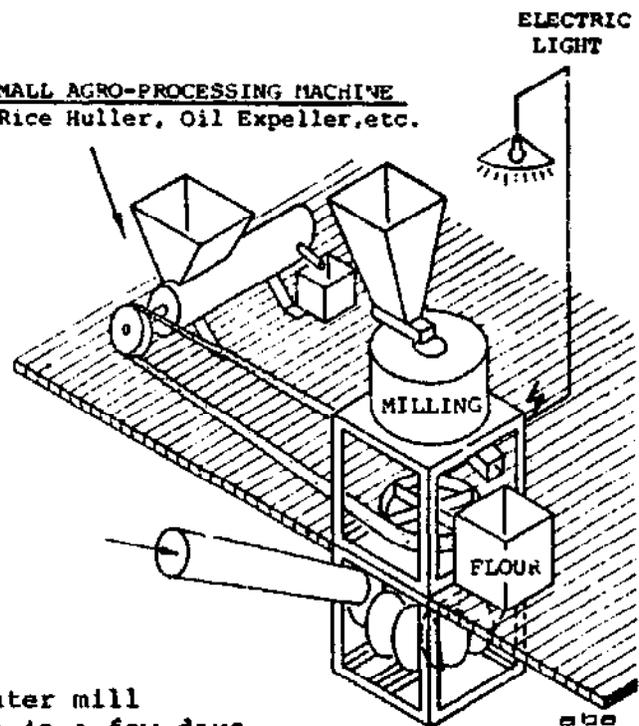
Transmission:

by belts mainly, electricity for lighting purposes mainly.

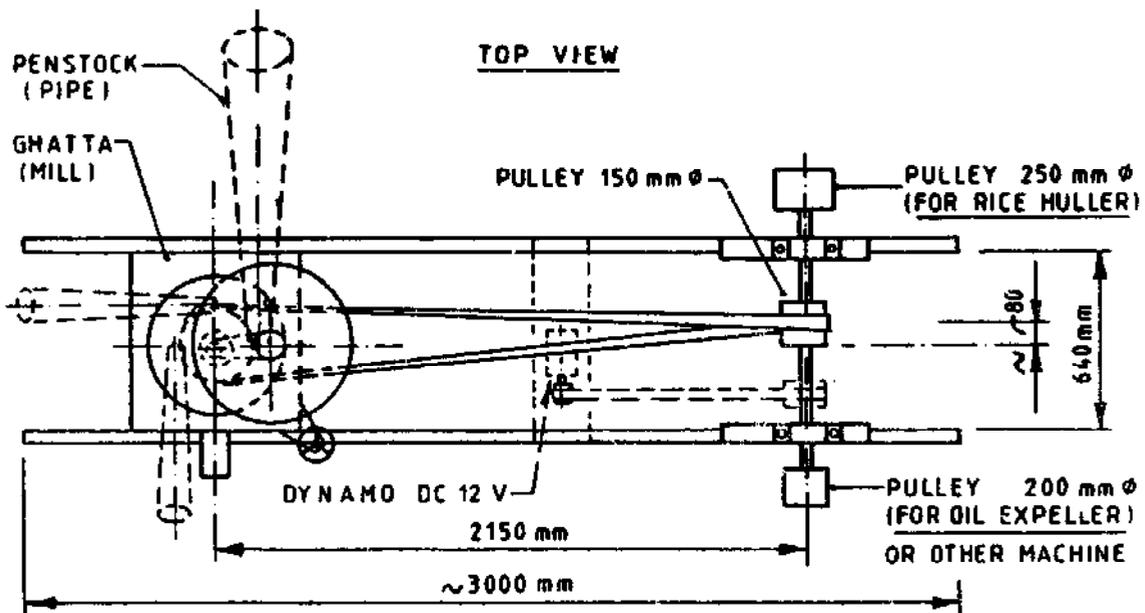
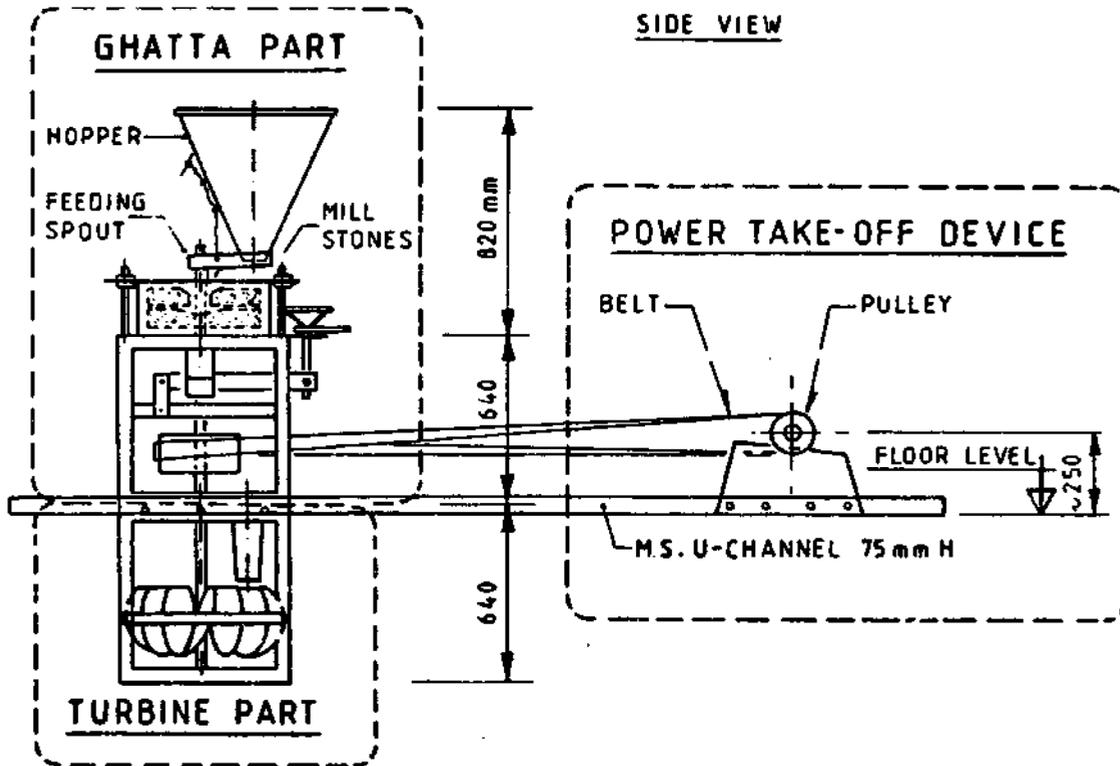
Installation Time:

If replacing an existing water mill the installation can be done in a few days.

SMALL AGRO-PROCESSING MACHINE
-Rice Huller, Oil Expeller, etc.



MPPU ASSEMBLY



M P P U

The Multi-Purpose Power-Unit (MPPU) was developed here in Nepal and is being manufactured locally. The units are made to standard sizes and in portable loads so that they can be transported by porters to quite remote areas.

The unit consists of three parts:

- The top section houses a grindstone and a hopper for grinding maize, wheat, rice, *khodo*, or other grain. The grindstone is unusual in that the upper stone is suspended while the bottom stone turns and does the grinding. The two stones are enclosed in a dust cover to prevent dust from falling on the floor and flour from being blown all over the room. As the flour is thrown out, it is automatically swept round with a brush and very neatly dropped through an outlet straight into a sack or a container. If the owner is not interested in grinding grain, this top section of the unit can be detached and a pulley fixed to the vertical shaft to provide power for some other purpose.

- The middle section houses the power transfer and the lifting device for the grinding stone above, and is the real heart of the unit. It contains the shaft with the main pulley. Power is provided by the water wheel fixed below. The vertical shaft turns the horizontal axis fixed on the power take-off. The latter has a pulley at either end for working any suitable machine. Many MPPU's have a 12-Volt DC dynamo which provides electricity for the millhouse and the operator's house, if he lives in the same building.

- The bottom section holds the water wheel. This section is installed below floor level. A pipe is fitted to this turbine, which leads the water from above to the water wheel.

The essential feature in terms of the work that can be done is the horizontal drive shaft; the power take-off. There are many different appliances that can be fitted, converting the unit into the following:

- Food Processor: Flour mill, rice mill, oil expeller, *chura* mill (rice flattener), paddy and wheat thresher, pestle and mortar, grinding, small scale irrigation, village water supply, etc.

- Cottage Industries: Wood-working machines, planer, bench saw, circular saw, lathe, looms for silk and cotton,

- Domestic Use: Small scale electricity production. The unit can run a small DC, 12-Volt dynamo, or also a small AC generator, 220 Volt to supply lights and some power for the miller and the neighbours in the village.

OPERATION

The MPPU works quite similarly to the traditional water mill (*ghatta*), and it does not need long experience to run this device successfully. Some difficulty may be encountered when the stones need redressing and proper resetting to the correct position. To achieve satisfactory grinding it is essential that the stones are roughened regularly and that they are fitted at perfect horizontal level.

BEFORE STARTING THE M P P U

1. First priority should be given to keeping the machine clean. Lubrication is required wherever oil cups, grease cups or oiling holes are provided. The bearings need regular greasing, depending on their daily use, about every week.

Make sure that the water inlet is cleaned regularly and remove all the leaves and other materials from the intake grill.

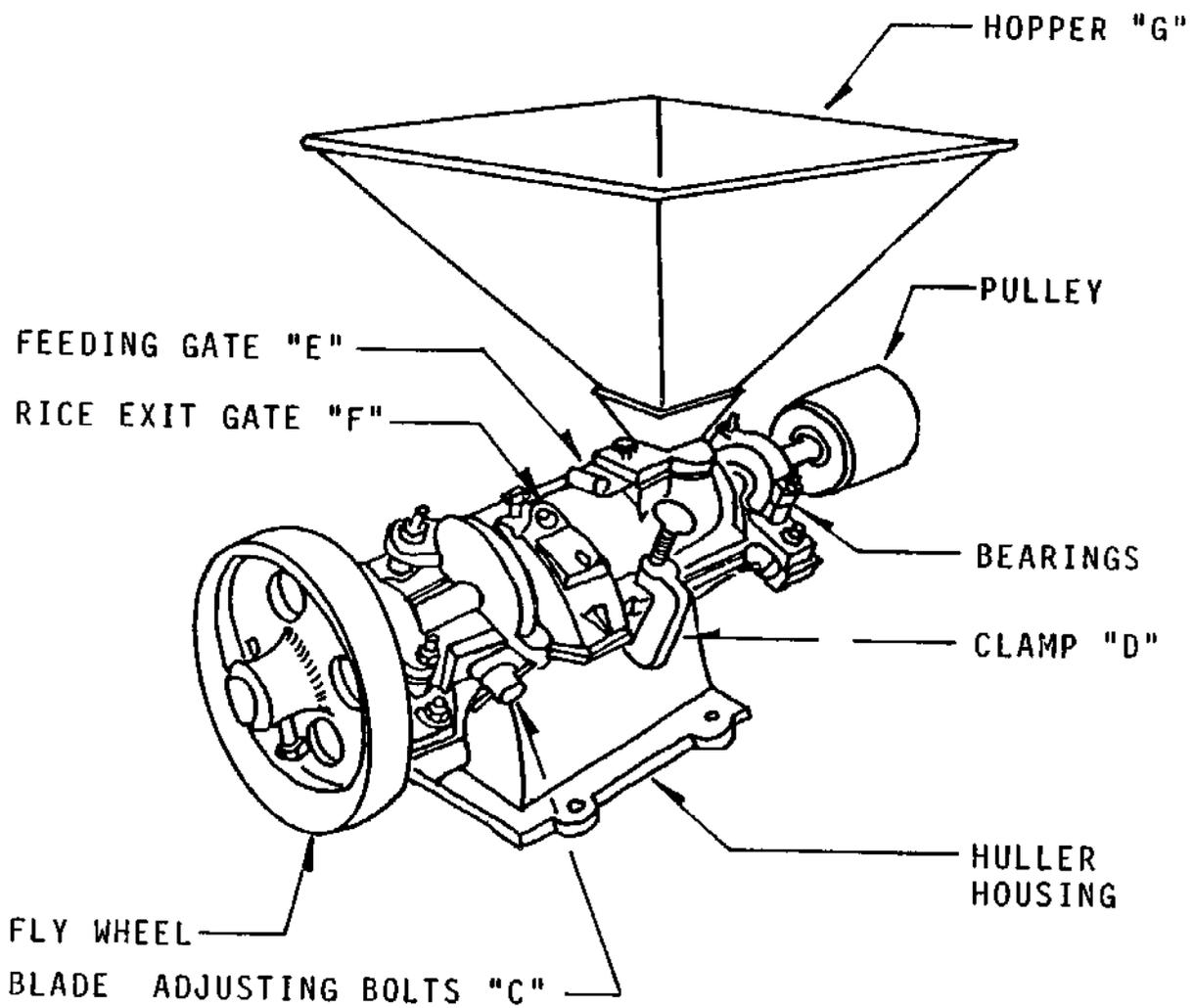
2. Machine: The moving parts have to be checked before starting the machine. The main shaft must rotate freely and there should be no clogging between the stones. Then block the grinding stones by turning the handle to the right, and the shaft can no more turn. Remove the belt from the main pulley.

STARTING

After following the instructions above, the operator can open the gate at the intake. First of all the machine should be run without a load for about one minute. This is to allow for proper checking. After that the operator can start grinding by disengagement of grinding stones (by turning of the hand wheel) and adjust the flow of grains accordingly.

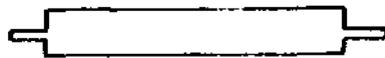
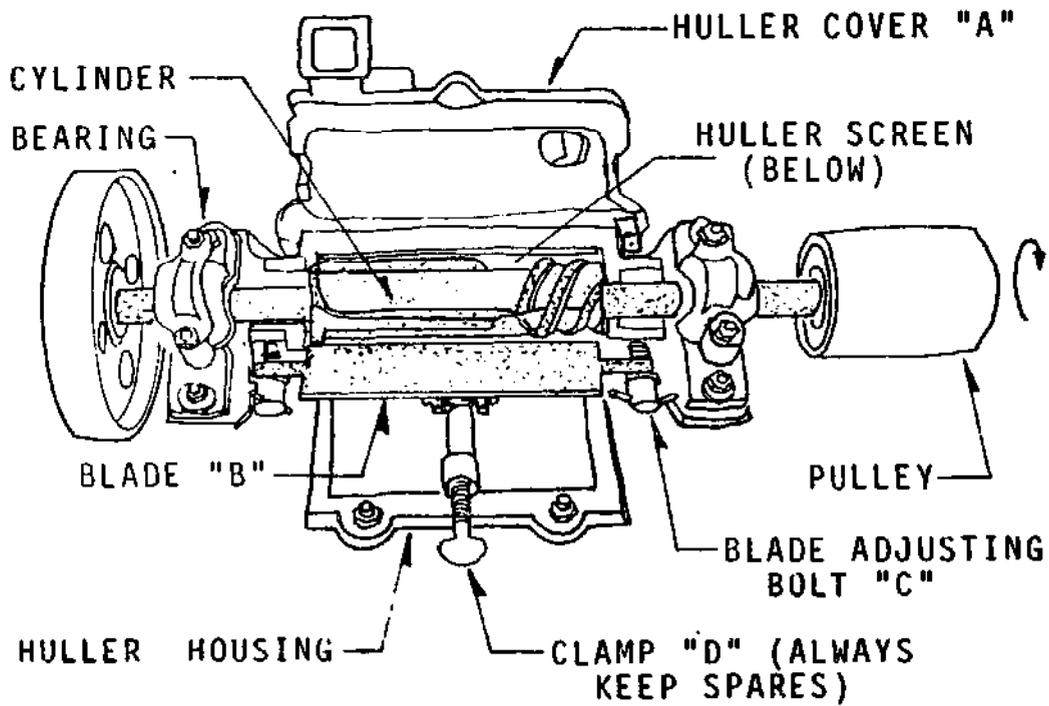
Note: for reasons of safety it is always better to stop the machine whenever belts are be connected or removed from the pulleys.

RICE HULLER



RICE HULLER

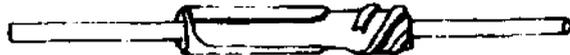
FRONT VIEW / OPENED POSITION



HULLER BLADE



HULLER SCREEN
(FINE, MEDIUM, COARSE)



HULLER CYLINDER

OPERATION OF RICE HULLER *

Before starting the machine

1. Open up the cover "A" of huller and adjust the hulling blade "B" in front of the machine by means of the adjusting screw "C". The space between the edge of the hulling blade "B" and the ribs of the cylinder should be about 2 to 4 mm at the feed end, and slightly more at the discharge of the huller.
2. Fix a piece of cloth or felt for the sealing over the shaft
3. Close the cover "A" and fasten securely by means of clamp "D".
4. Close the slide "E" under feed hopper.
5. Open the discharge slide "F".
6. Lubricate all bearings

Then the machine can be started!

After starting the machine

1. Fill up the hopper "G" with clean paddy.
2. Gradually open the slide "E" under feed hopper and allow the huller to fill slowly.
3. When the feed slide "E" is full open gradually close the discharge slide "F" until all the rice is being hulled. When all the rice is being hulled it can be allowed to run into the

* Ref: Parts of text: Lewis C. Grant, Ltd., U.K.

polisher. Any variation in the amount of scouring required can be regulated by means of the discharge slide "F": for finer hulling discharge may need to be delayed. After the hulling blade has once been correctly set it should not be altered so long as the same quality or size of rice is being handled. When grains are being hulled larger or smaller than those for which the machine has originally set it will be necessary to increase or reduce respectively the distance between the hulling blade and the ribs of cylinder.

In case of a choke

1. Close the feed slide "E".
2. Note position of hulling blade "B".
3. Draw hulling blade "B" away from cylinder by means of adjusting screw "C".
4. Re-start machine.
5. Re-set hulling blade "B".
6. Gradually open feed slide "E".

To stop the machine

1. Close the feed slide "E" .
2. Allow huller to empty itself. Unless this is done the huller can not be re-started except by drawing back the huller blade as in the case of a choke.
3. Stop the machine by removing of the belt.

Special Notes

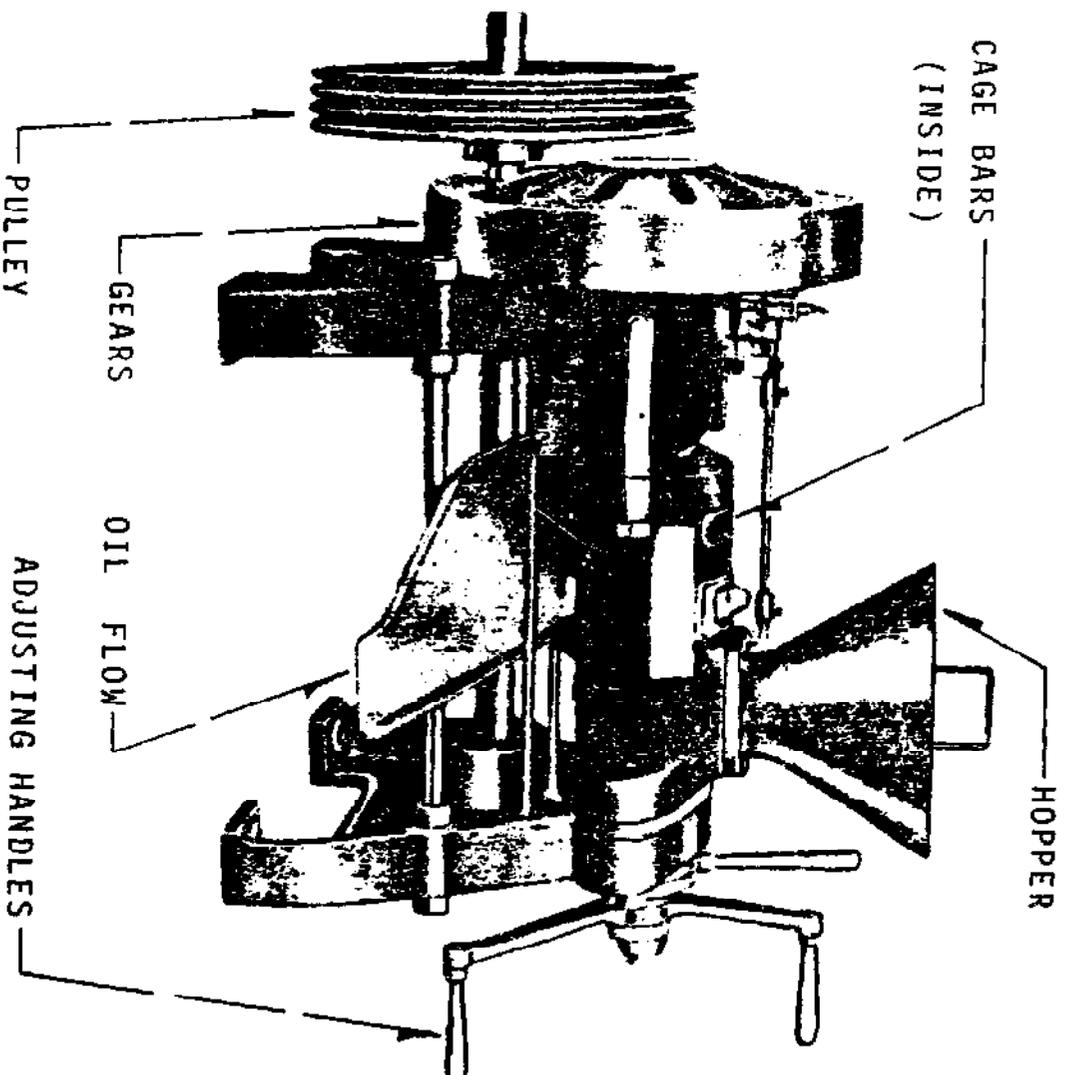
1. Always keep plenty of rice in the feed hopper.
2. Make sure that the stones or metal pices never enter the huller.
3. Always work the machine to its maximum capacity. It will give better results.
4. Always keep the bearings or bushes well lubricated.
5. Where a suction fan is fitted the discharge pipe must be as large as the fan outlet and lead to a place where the air can escape easily.

Speed of the machine

The machine must be driven by a water turbine, engine or motor of sufficient power. The following range of speeds is found to be most effective:

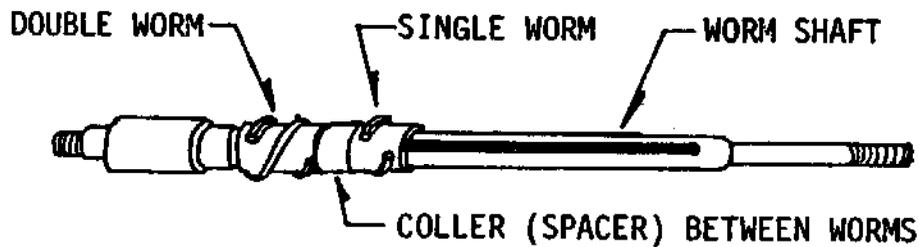
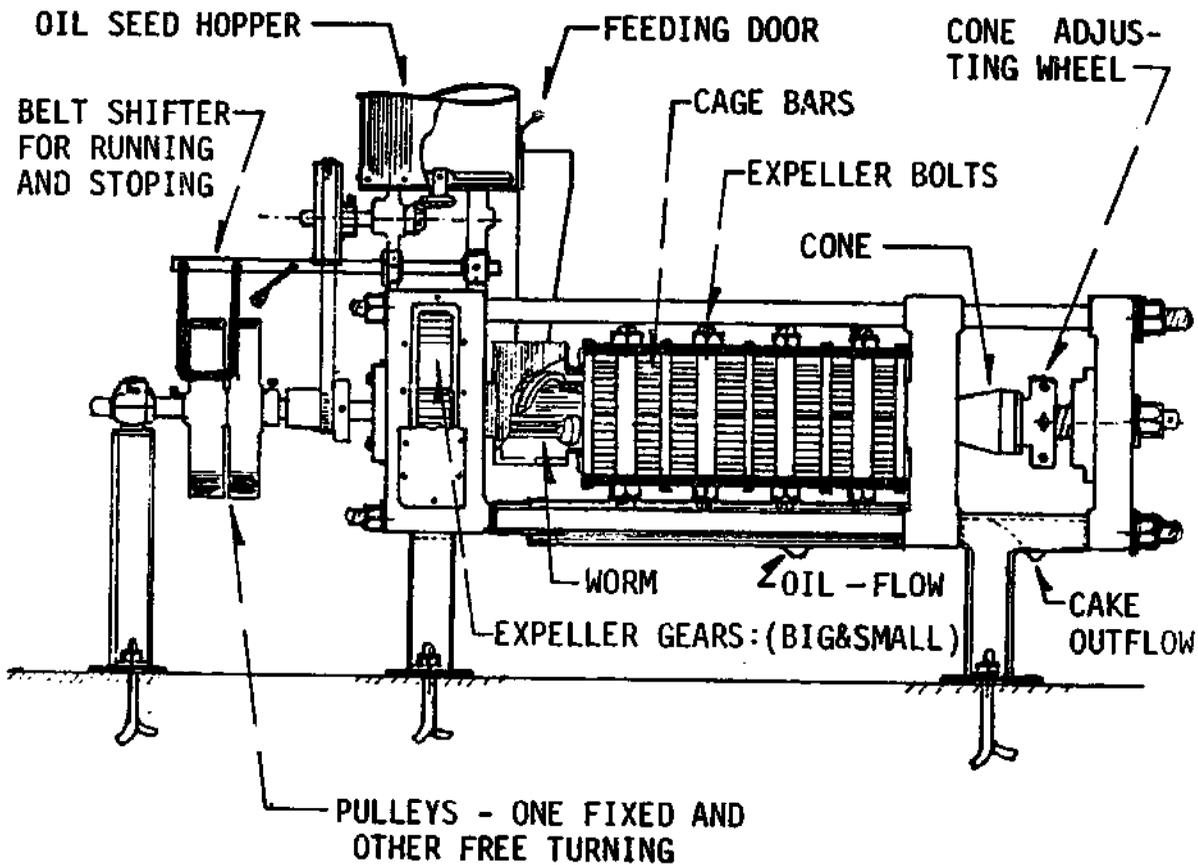
OSTAD HULLER SPECIFICATIONS				
Type of huller	Capacity per hour / paddy	Driving pulley	Speed R.P.M.	Power required
Baby, No. 5	200 kg	6" x 3"(4")	750	5 H.P.
No. 4	500 kg	8" x 4"	1000	7.5 H.P.
No. 8	700 kg	10 x 5"	900	10 H.P.
No. 2	1000 kg	12 x 6"	850	15 H.P.

OIL EXPELLER BABY SIZE

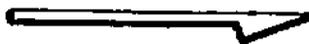


OIL EXPELLER

4-BOLT OR 6-BOLT SIZES



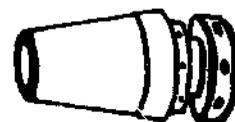
BLADE



CAGE-BAR



CONE



OPERATION OF OIL EXPELLER

Materials to be processed:

Soyabeans; Mustard seeds, Cotton seeds, peanuts, rapeseeds, sunflower seeds, groundnuts (*badam*) and *churee*. In Nepal the most-used seeds for oil extraction are mustard seeds, groundnuts and soyabeans. The *churee* is also used, but it needs a special, adjusted device. Some trials have been conducted with rapeseeds, which however, are not commonly accepted by the people.

Operation

Experience is needed to operate such oil expellers for any type of seed. The most difficult seed for successful extraction is the *churee* seed, as mentioned above.

Feeding of machine

The seeds can be fed into the oil expeller (screw type), and no preboiling is necessary. However, in cases where the traditional *Kolu* type expeller is being used, preboiling and crushing is required. This oil is very much liked by the *Newars* in the Kathmandu valley. The cakes of the *Kolu* method can further be re-expelled by subsequently passing them through the Indian screw type expeller.

Using the standard oil expeller, the expelling procedure generally must be repeated. Normally for the second expelling of cakes it is necessary to add a small quantity of water to moisten the hard cakes - otherwise the machine will clogg or jam. (Oil mixed with water as such is not desirable, but in Nepal the oil is boiled

before being used for cooking, and the water evaporates from the oil). With a high standard oil expeller a single expelling may be sufficient, provided sufficient power is supplied and the machine is properly adjusted.

Before starting the machine

1. The first priority is keeping the machine clean. Lubrication is required wherever oil cups, grease cups or oiling holes are provided.
2. Machine: the moving parts have to be checked before starting the machine. The main shaft must rotate freely and there should be no clogging inside the chamber.
3. Seeds: The seeds brought by the customers must be checked by the operator. These seeds must be clean and free of all foreign matter. A small nail, a piece of a broken bangle or any small object can spoil either the machine or the quality of the oil extracted.

Starting

After all the preconditions are met, as mentioned before, the operator can fit the belt on to the pulley. First of all the machine should be run without a load for about one minute. This is to activate the worm shaft and cage. Then the seeds can be fed slowly into the machine. Do not tighten the worm shaft at first. Let the seeds pass through the machine without being pressed. Only when the flow of seed is continuous can the cone of the worm shaft be tightened and then it must only be turned until

the oil begins to drop. The tightening can be continued until the cake leaves the machine in a dry condition.

It is important to insure the continuous flow of seed at a constant rate without interruption or disturbance. Whenever the flow is discontinued it is very difficult, especially for beginning operators, to adjust again. Therefore a steady running period of five to six hours is required.

Note: in regions with freezing temperatures it is important to preheat the machine before the seeds are fed into it, otherwise the oil clogs the machine.

After completion

Baby Oil Expellers need daily cleaning of the worm and outlet cone. This is quite simple work as the shaft can easily be removed.

4-bolt, 6-bolt or 9-bolt machines need to be cleaned now and then if in daily operation. When the machine is not in use for several days, a thorough cleaning of cake outlet, chamber and cage bars are required.

POSSIBLE TROUBLES		M P P U
Defect	May be caused by	Remedy
Mill won't turn	No water supply	check supply canal clean intake grill
	too much load fixed	remove the belts from the pulleys disengage the grinding stones (from grinding position)
	blocked turbine	check the turbine parts, remove dirt or any obstructive materials
Mill does not turn fast enough	insufficient water is supplied	check canal and intake grill
	too many machines connected	remove belts from pulleys of additional machines connected
	nozzle too big	replace nozzle by smaller one
Strange noise from the turbine part	worn out bearings	check the different bearings and replace the spoiled one
Coarse grinding	surface of stones has become polished	remove stones for redressing and grooving
	inappropriate feeding	adjust feeding device properly (less quantity)
	Wrong levelling of stones	it is essential to have stones properly levelled: check on marks on stones after having removed them
Hot flour	Overgrinding of material, due to over- tightening the handwheel	open hand wheel - increase gap between the stones. Fine grinding may require grin- ding two times / keeping stones rough.

POSSIBLE TROUBLES

M P P U

Defect	May be caused by	Remedy
<p>Belt slips -remains on the pulley</p>	<p>OVERRATING OF power take-off ratio Polished surface of pulleys Stretched belt Machines fixed too near to the power take-off pulleys Under-sized belts</p>	<p>Remove belt from one of the machines use dressing paste (tar) Needs to be shortened by cutting and fixing of a new connection, or readjustment on sliding stand fixation for proper working conditions some 1.5 mtr to 2 mtr distance between the pulleys are required. Use larger belts (in width)</p>
<p>Belt slips from the pulley</p>	<p>OVERRATING OF power demand Inaccurate alignment of machines</p>	<p>blockage of agro processing machine (e.g. too much feeding into the oil expeller, rice huller, etc.) Adjust position of machines properly so that the belt can remain easily on the pulleys. Do not use sticks or other "aids" to keep belt in position: this method is dangerous and wears down the belts rapidly.</p>
<p>Unequal turning of mill and turbine</p>	<p>Troubles in bearings</p>	<p>Cleaning and greasing of bearings Replacement of bearings may be necessary</p>

POSSIBLE TROUBLES		RICE HULLER
Defect	May be caused by	Remedy
Machine stops	overfeeding of rice	release it by hand-turning counter-clockwise
	wrong screen in the machine	choose the correct size of screen (either the fine or the larger size one)
Hulling is bad	wet paddy	paddy must be properly dried before being fed into the machine.
	uncontrolled feeding and discharge	both feeding and discharge need proper adjustment
	insufficient adjustment of blade	it needs proper adjustment to the size of rice to be hulled
Separation is insufficient	blocked screen	open the clamp and then open the cover, remove the screen and clean it. In case the screen is worn out replace it by new one.
Much braking of grain	poor adjustment, overtightening of huller-blade	increase gap between blade and huller blade by loosening the huller screen
Poor hulling	worn out huller shell and blade	check huller shell; if the teeth are worn out then the huller shell needs to be replaced. Blade can be reversed for further use

POSSIBLE TROUBLES		OIL EXPELLER
Defect	May be caused by	Remedy
No oil	cake outlet cone is not properly adjusted and therefore does not press enough to expell the oil - only the cake (oil laden) leaves the cone	The cone has to be tightened gently
	Cage bars are clogged	Cage bars have to be cleaned
	Worms (of shaft) are worn out	Replace used shaft with a new one
	Worm shaft does not turn a) shaft is broken b) keys are worn out c) the gears are worn out	Repair or replacement of the mentioned parts are required
	Overtightening of bolts (at 4-bolts or 6-bolts machines),which presses the cage bars together and leaves no space for the oil to flow	loosen the bolts slightly
Machine stops	Cone is pressed too much	loosen cone
	Not sufficient power is provided	Power requirements: Baby expeller 4-bolts expeller 6 bolts 3 H.P. 5. H.P. 7 H.P.
	Clogging of machine through very hard cake (super dry) which in case of more power supply may also damage the gears and the shaft!	Complete cleaning of cone, cage bars, worm and shaft

POSSIBLE TROUBLES		OIL EXPELLER
Defect	May be caused by	Remedy
Not sufficient quantity of oil is coming	very poor quality of oil seeds	use better quality of oil seeds (no other remedy)
	Cone and cage bars and worm shaft are worn out	Replace old parts by new ones
	Power to turn the machine is not sufficient	Increase the power supply e.g. more quantity of water to the turbine
	Flow of seeds is discontinued Chamber is cold (main body of the machine)	pay attention to careful operation Preheat the chamber, e.g. through running of the machine or any other heat source to be done carefully and slightly only.
	Worms are fixed the wrong way around on to the shaft	Pay attention to the proper re-fixing of these worms
	The bolts (on the 4-bolts of 6-bolts machines) are extremely tightened.	Loosen the bolts slightly.
Belt slips	Too long belts	Tighten belts
	Too many seeds are fed into the machine	control regular, adjusted flow
	Slippery pulley and belts	Apply belt paste
Broken Cage Bars	Overloading of machine, etc., for reasons as mentioned before	Stop machine <u>immediately</u> to avoid <u>entire</u> damaging of machine (due to the grinding effect of the broken pieces in the chamber), Before inserting new cage bars the chamber has to be cleaned properly.

POSSIBLE TROUBLES		OIL EXPELLER
Defect	May be caused by	Remedy
Strange noise while machine is running	Defective bearings	Bearings need to be replaced regularly, (sometimes even new machines have poor quality bearings) Note: keep spares on stock!

MAINTENANCE

OIL EXPELLER

Parts	Method	Timing	Available from
<p>Bushes need regular greasing with first class grease and lubrication with oil only.</p>	<p>Press new grease into the bushes by applying the grease gun to the nipples. Replace old grease by pressing new grease into the bushes, until old grease has left the casing.</p>	<p>after appr. 600 - 800 hrs replacement regular greasing daily or weekly</p>	<p>Motor shops, buy good grease only Keep replacement bushes on stock, available from local market, or order with machine from the supplier</p>
<p>Gears</p>	<p>apply grease with a stick</p>	<p>after appr. 100 hrs running Replacement: after some 600 - 800 hrs (as the material is not of hardened steel)</p>	<p>on agric. machine market for example in: - Kathmandu - Bhairawa - Birgunj - etc.</p>
<p>Cage Bars, Worms, Cones</p>	<p>Cleaning after use, dry and clean regularly</p>	<p>Baby oil expeller daily cleaning 4-bolts + 6-bolts within some hrs, for longer stand still period of several days the shaft and chamber has to be cleaned entirely Life expectancy: 600 hrs - 800 hrs</p>	<p>On agric. machine market</p>

POSSIBLE TROUBLES		DYNAMO
Defect	May be caused by	Remedy
No light	Spoiled lamp	replace
	fuse blown	check circuit, repair, replace fuse wire
	brushes worn / brushes dirty	replace carbon / remove and clean
	bearings or bushes spoiled	replacement needed
	Low speed: minimal required speed appr. 1000 r.p.m.	more water required reduce load on dynamo (less bulbs burning) tighten belt change pulley
Noise while running	bearings or bushes spoiled	need to be replaced
Insufficient electricity	speed is too slow	allow more water to pass through the turbine
		remove other machine-belts, disengage grinding stones
	reduce electricity consumption	
	Driving belt is loose	tighten the belt by pulling dynamo body and lock at position

SPARES

FOR ALL MACHINES

- Belts (Goodyear, Dunlop, etc.)
- Beltlocks
- Belt paste
- oil (and can), first class Mobil oil only
- grease (first class only: bearing grease)
- Ball bearings and bushes

M P P U

- 1 set of grinding stones

RICE HULLER

- 3 pcs Huller screen
- 1 pc Huller shell
- 3 pcs Huller blades
- 6 pcs Huller clamps (breakable!)

OIL EXPELLER

- 1 set of cage bars
- 1 pc worm shaft
- 1 set of blades
- 1 pc cone

DYNAMO

- 6 pcs of light bulbs (12V-40W) gasfilled,
- 2 pcs of lamp sockets
- 1 V-Belt (or flat belt)
- 1 set of carbon brushes
- 1 kit of fuses / wire.

1 SET OF HANDTOOLS

MANUFACTURERS OF IMPROVED WATER MILLS

- 1) KATHMANDU METAL INDUSTRY
12 / 514 Quadon, Nagal (Chettrapati)
Kathmandu (Mr. Akkal Man Nakarmi) Tel: 21 40 69
- 2) NATIONAL STRUCTURE AND ENGINEERING COMPANY
Patan Industrial Estate
Lalitpur / Kathmandu Tel: 52 14 05
- 3) NEPAL YANTRA SHALA, Mechanical Workshop
Patan Industrial Estate
Lalitpur / Kathmandu Tel: 52 21 67

FURTHER INFORMATION AVAILABLE

- Multi-Purpose Power-Unit (MPPU), with horizontal water turbine
Volume I: Basic Information
by A.M. Nakarmi & A. Bachmann
Publisher: Sahayogi Press, Tripureshwar, Kathmandu
- New Himalayan Water Wheels
by A. Bachmann & A.M. Nakarmi
Publisher: Sahayogi Press, Tripureshwar, Kathmandu
- Fuel Gas from Cowdung / Third Edition
by B.R. Saubolle & A. Bachmann
Publisher: Sahayogi Press, Tripureshwar, Kathmandu
- Mini Technology, Volume I & II
by B.R. Saubolle & A. Bachmann
Publisher: Sahayogi Press, Tripureshwar, Kathmandu
- New Nepali Cooking Stoves (Edition in English and Nepali)
UNICEF-Kathmandu