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MOTORCYCLE POWER TAKE-OFF FOR AGRICULTURE[1]

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ABSTRACT

*The successful design of several types of motorcycle power take-off (**M-pto**) has opened possibilities for the use of a range of attachments matched to the power of the more popular motorcycle models in Asia. This paper reports on the implementation of the motorcycle power-take-off for low-speed and high speed applications utilizing some existing IRRI machines.*

1. INTRODUCTION

The motorcycle is a popular mode of transport in developing countries. It is also a latent source of rotary power that may be applied to drive equipment. Potential agricultural equipment applications include pumps, threshers, axial-flow fans, the IRRI micromill, coconut graters, wood lathes, forage choppers or even small-scale electric power generation.

Motorcycle sales in the developing world are steadily growing due to the low cost and economical operation as compared to 4-wheeled or other vehicles. Worsening traffic conditions in urban areas also make the motorbike a preferred individual transportation mode.

The motorcycle however, needs some adaptation to be used as a stationary power source. In this paper we reveal several ways that were evaluated to provide rotary power from a stationary motorcycle.

2. OBJECTIVE

The main objective of developing a motorcycle power-take-off **(M-pto)** was to provide a source of rotary power for stationary equipment. In setting out to do this, we set a design criterion that the driven equipment should be easily and quickly attached to the motorcycle. It must be safe to use and the cost of modifications should be reasonable, or cheap enough to attract users. Finally, the engine of the motorcycle should not be overloaded or overheated in operation.

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3. MATERIALS AND METHODS

3.1 M-pto design at IRRI. Motorcycle power-take-off design at IRRI was initiated by the senior author in mid-1991. Several ways to do this emerged as we sought to meet the challenge, Figure 1. Prototypes were designed by B. L. Paita. Initially a friction-type M-pto using the motorcycle rear wheel to drive a smaller roller with an output shaft was designed, items 5 on Figure 1. The driven roller caused considerable wear on the rear tire. Difficulty was also encountered in fixing the attachment to the M-pto and there was considerable vibration and extra noise. It was considered that the tyre problem was intractable and we looked for superior solutions.

3.2 Low-speed M-pto. Design work continued which produced the low-speed M-pto, exploiting the drive chain, utilizing the rear wheel as a flywheel and the motorcycle transmission to provide control during engagement of the M-pto as well as selection of output speed through the motorcycle gear selection lever. Two types of chain drive M-pto's were evaluated:

Detacheable chain-sprocket-pulley M-pto. This M-pto set-up is a detacheable fixture, with a mounting bracket that can be fixed on the rear wheel pivot arm of the motorcycle. When the motorcycle is in transport mode the mounting bracket can be used as a footrest for the pillon rider. Output speed of this configuration ranges from 300-800 rpm, depending on the carburetor setting, and the engaged transmission gear. This detacheable M-pto transmits power through a sprocket in contact with the motorcycle chain, a pulley is attached on the other end of the shaft which drives the equipment by V-belt. This M-pto attaches to the pivot arm of the motorcycle by using existing brackets on the motorcycle.

Permanent-type sprocket-chain-sprocket M-pto. The permanent M-pto attachment involves a driven sprocket attached to the rear wheel sprocket of the motorcycle. Power is transmitted from the standby-sprocket by chain to a smaller sprocket which drives a jackshaft which may in turn be mounted to a motorbike sidecar. The sidecar serves as the frame for the attachments and gives mobility, eliminating the need for a separate transporting arrangement if the equipment is to be shifted from job to job.

3.3 High-speed M-pto. A high-speed M-pto was achieved by directly tapping into the crankshaft of the motorcycle. This is possible by removing the magneto access cover on the left crankcase cover. This M-pto was designed by Godofredo Salazar. He modified the magneto nut which fixes the motorcycle magneto to the left-side crank shaft. The modified magneto nut attaches to a cardan joint, the opposite of which mates with the power take-off shaft. The plug-in M-pto provides for engine speed drive (e.g. 3000-5000 RPM) useful for pumps or generators. Other methods maybe used to attach the cardan shaft, but in any case care has to be taken to keep dust out of the magneto housing area.

4. RESULTS OF DESIGN WORK

The motorcycle power-take-off can be categorized as either low-speed or high-speed, detachable or permanent, depending on the kind of M-pto mounting. The motorcycle power-take-off designs described here do not hinder normal operation of the motorcycle as a vehicle, and can be attached to any motorcycle

model with minimum adjustments and modification. It may be possible to attach more than one power-take-off on the motorcycle.

The detacheable M-pto (Fig. 2) has been tested on several items of IRRI equipment with favorable results. These included the mini-thresher, batch-dryer axial-flow fan, coconut grater attachment and IRRI micromill. Modifications will be undertaken to refine utilization of the M-pto to drive the batch-dryer axial-flow fan. A new muffler that is oriented upwards is needed to direct exhaust gases from being sucked into the plenum of the batch dryer. We tested both loose and tight-side drives and concluded that either can be exploited, provided that the driven sprocket is large enough for durability.

The permanent type of M-pto (Fig. 3) uses a sprocket mounted parallel with the regular driven sprocket of the motorcycle inside and centered on the hub of the rear wheel. Rotational motion is transmitted to the attachment using a drive chain which engages on a smaller sprocket mounted on a shaft fixed to a chassis or other mechanism that can be detached from the motorcycle. This provides a "low-speed" rotary power source; capable of being declutched and using the regular gearbox of the motorcycle.

The temperature of the motorcycle engine was monitored by using a high-temperature thermocouple probe positioned on the engine cylinder head. With the engine at idling, and the coconut-grater attachment operating temperature was observed to go up to 285°C. To counteract possible engine heating-up, a blower or a fan can be provided to simulate the air draft generated by a moving motorbike. During test for the RM150 micromill airdraft was provided by using a cyclone and directing the upward-flowing air into the motorcycle engine. Likewise, a supplementary muffler was also provided to direct exhaust emissions away from the rice micromill operator.

The development of this cardan joint M-pto (Fig. 4) for high speed applications has opened possibilities for simultaneous operation of two attachments. Plans are on the way to equip the motorcycle with two power take-offs, operating simultaneously, with the sprocket-chain-sprocket M-pto to drive a motorcycle-driven drilling rig and the cardan-joint M-pto to drive its accompanying jetting pump.

In summary, some of the more novel developments of this research work were as follows: The design of motorcycle power-take-off in general, and in particular m-pto using a detachable and/or fixed sprocket which does not hinder the normal operation of the motorcycle when the m-pto is disconnected.

The design of a fixture composed of hitching shaft which connects to the crankshaft of the motorcycle engine, and utilizes a suitable universal/cardan joint to transmit rotational power to the implement.

The design of a multi-purpose chassis that can be mounted at the rear of the motorcycle and that can accommodate suitable attachments such as the IRRI Micromill.

Alternatively, the motorcycle could be equipped with two power take-offs for simultaneous operation, as for example, if needed to drive a water injection pump in conjunction with a water boring rig.

5. CONCLUSION AND FUTURE WORK

Several variations of motorcycle power take-off have been developed. They are simple and adaptable, in terms of minimal modifications to install the power-take-off and in the range of attachments that can be driven.

The RM50 Micromill has been successfully attached to the motorbike by means of the detacheable chain-sprocket M-pto. The RM150 was attached/driven by motorcycle using the permanently mounted sprocket M-pto. Testing continues for this motorcycle-micro-ricemill combination. Transportability should be thoroughly assessed by asking entrepreneurs to try this particular rice milling set-up.

At present, the different M-pto set-ups are undergoing dynamometer tests at the Agricultural Machinery Testing and Evaluation Center (AMTEC), University of the Philippines at Los Banos.

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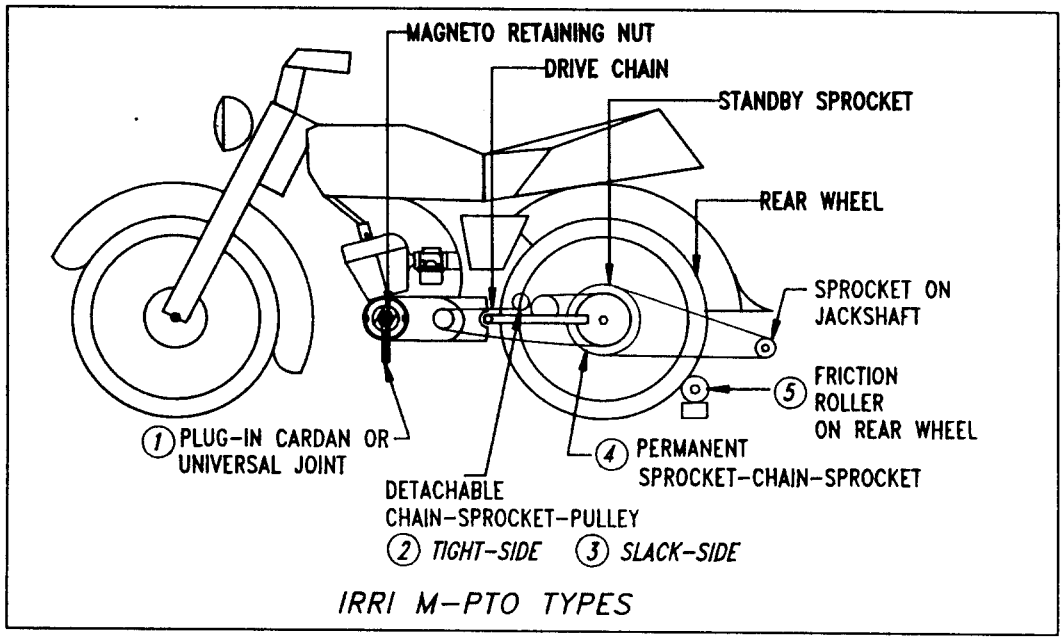

Fig. 1 **FIVE SUGGESTED POWER-TAKE-OFF LOCATIONS ON A TYPICAL SMALL MOTORCYCLE**

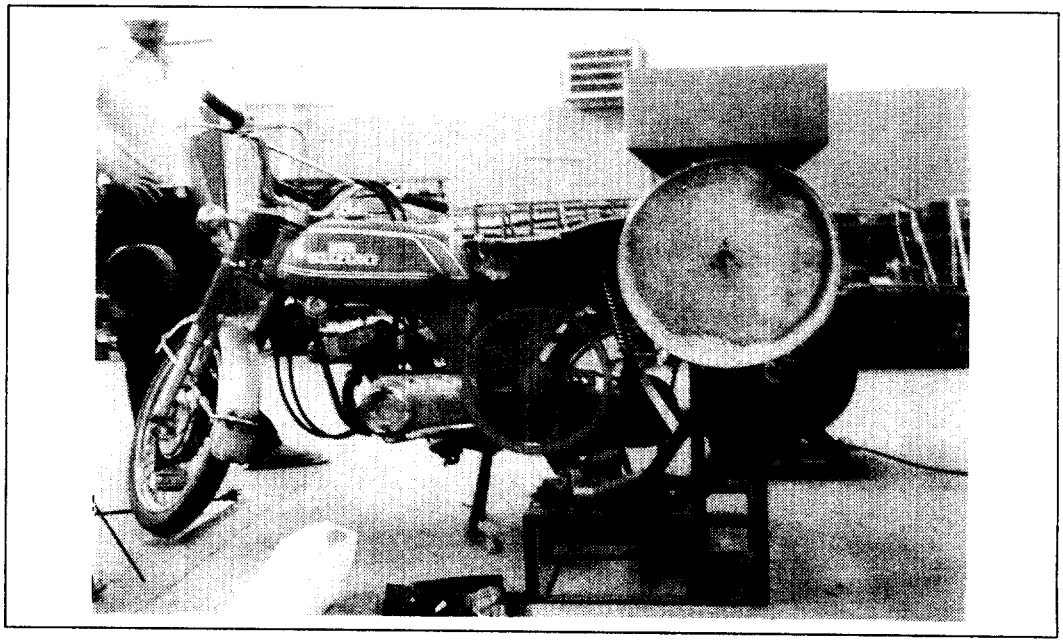

Fig. 2 **CHAIN-SPROCKET-PULLEY MOTORCYCLE POWER-TAKE-OFF DRIVING IRRI RM50 MICROMILL WITH COCONUT GRATER ATTACHMENT**

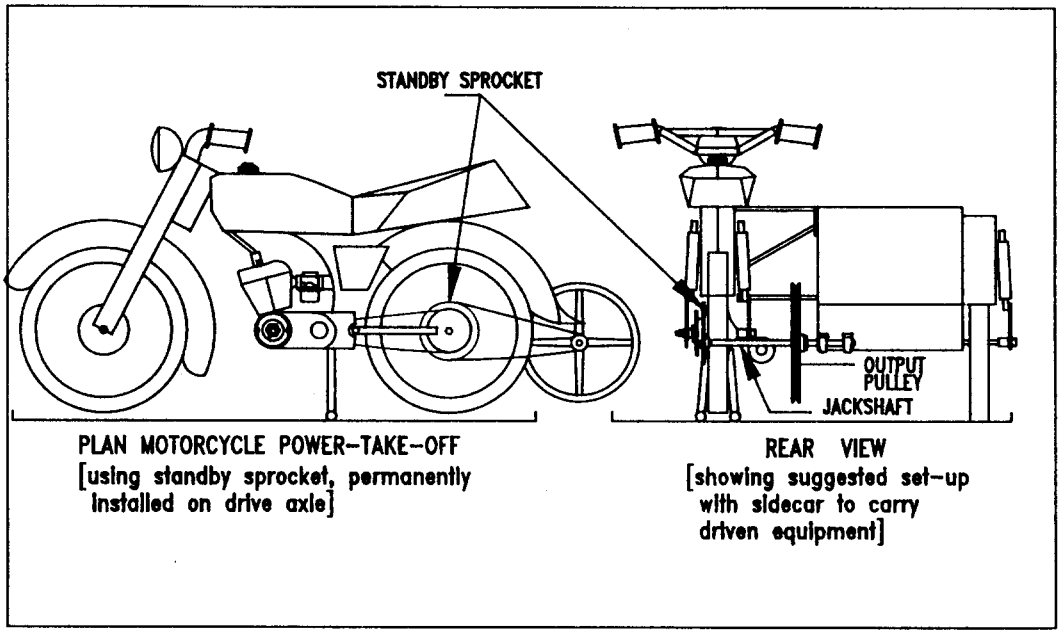

Fig. 3 **PLAN SHOWING SPROCKET-CHAIN-SPROCKET-TYPE MOTORCYCLE POWER-TAKE-OFF AND SUGGESTED SET-UP WITH A SIDECAR TO CARRY THE DRIVEN EQUIPMENT.**

Fig. 4 **PLUG-IN CARDAN-JOINT MOTORCYCLE POWER-TAKE-OFF DRIVING A 4" IRRI SIPA PUMP (Salazar, G. C. 1992).**