Progress Report on Micro-Gasifier Stoves and Heaters during 2006

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Defining Micro-Gasification

- Gasifiers use dry biomass to produce combustible gases **separate in both time and space** from where those gases are combusted.
  - Result: Cleaner emissions
- True gasifiers, quasi-gasifiers, & others
- Micro-gasifier devices are size-appropriate and intended for residential and institutional cooking and/or heating.

Two Different Technologies for Micro-Gasification

1. Top-Lit UpDraft (TLUD)
2. Continuous-Feed UpDraft
3. Others might be possible, but we have not yet seen them in functional cookstoves

All that follows is NEW in 2006!

Top-Lit UpDraft (TLUD) Gasifiers

- ***Production and costs of TLUD units:***
  - Reed “Woodgas Campstove”
    - 500 made in Mexico
    - Now manufactured in India
    - Retail American price: $55
  - “Champion Stove” natural draft TLUDs
    - Less than 100 in India at ARTI (some not used as TLUDs)
    - Indian production: $25 - $35 (includes stove body)
  - “Juntos B+” forced-air TLUDs
    - Only six prototypes in Cambodia
    - Approx. US$20 (without stove structure)

Top-Lit UpDraft (TLUD) Gasifiers

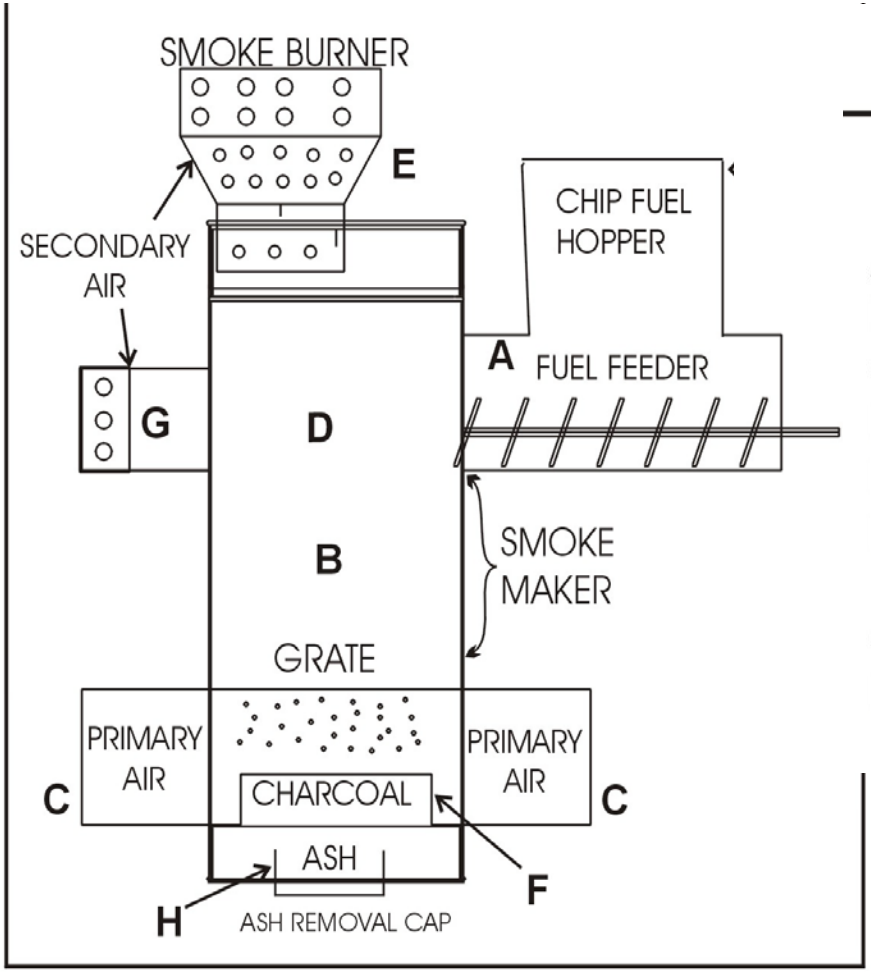
- ***Development and testing***
  - ARECOP sponsorship of 6 application projects
  - Dale Andreatta confirms low emissions
  - Additional suitable fuels for TLUD gasifiers
  - “Juntos B+” forced air TLUDs provide separate control of primary and secondary air
    - Project sponsored in Cambodia by GERES

The independent controls of both primary and secondary air allow the user to select the flame characteristics and choose between more diverse fuels in a single TLUD gasifier cookstove.

Control also facilitates research of combustion/emissions

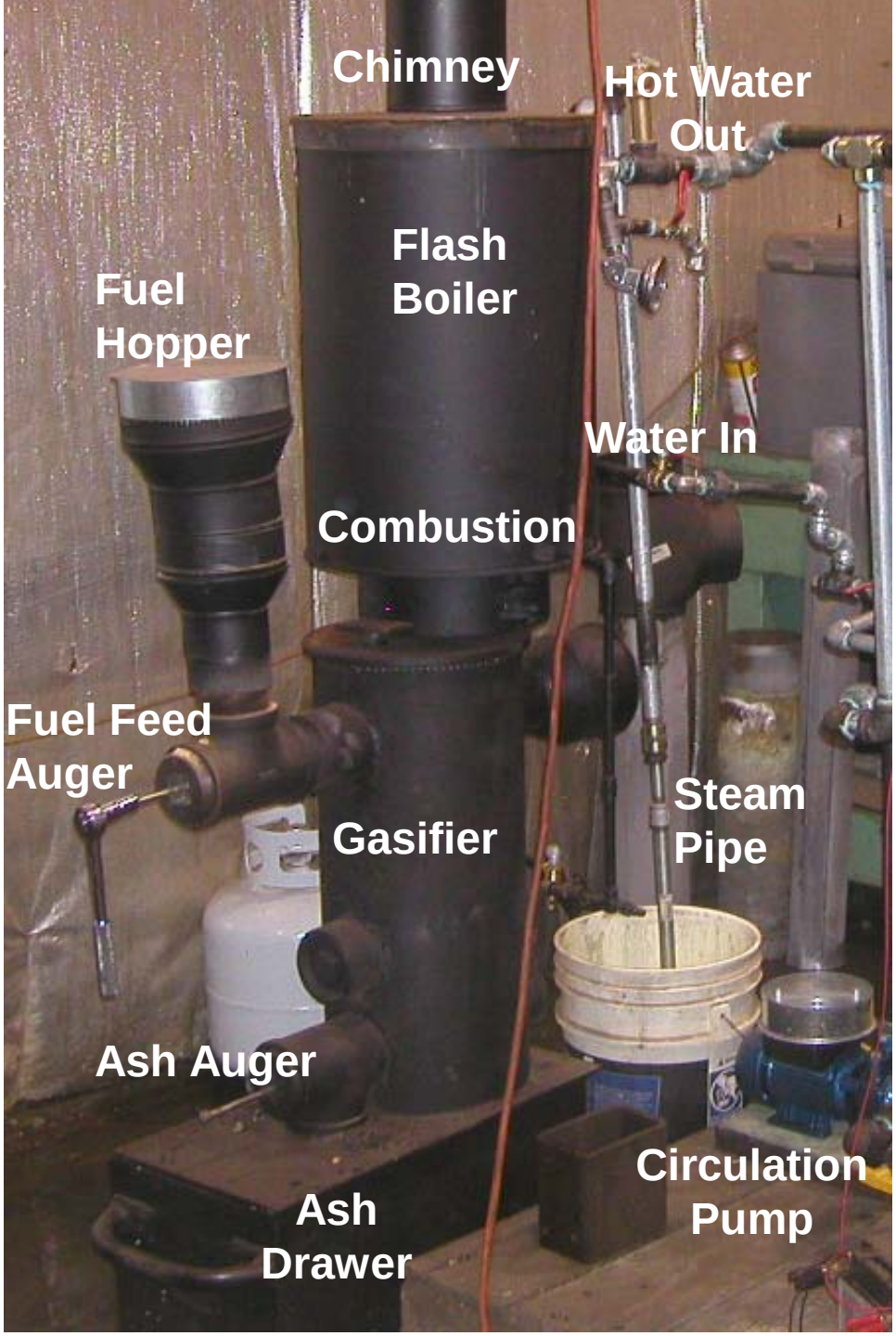
Continuous-Feed UpDraft Gasifiers

- Developed by Chip Energy of Goodfield, Illinois in 2006
- Advantages include:
  - Continuous operation
  - Easy fuel handling
  - Control of heat levels
  - Options for numerous convenience features
- Size Variations for different applications



HOW MICRO-GASIFICATION WORKS

A. Fuel is added from hopper onto fuel pile above grate.
B. Fuel is top lit with lighter fluid.
C. Air enters upward through fuel.
D. Hot smoke fills the "smoke maker" above the fuel.
E. Air enters the "smoke burner" for clean combustion.
F. Used fuel becomes hot char and keeps the in-coming raw fuel heated to release smoke (pyrolysis gases).
G. Openings for lower secondary air help control draft.
H. Ash and excess char are released after build up.



Biomass Furnace for Residential Heating

30,000 to 300,000 BTU

Process-Heat Gasifiers for Cottage Industry

- The variations are in the applications, not in the gasifier, so the differences are mainly above the level of incoming secondary air.
- Wide range of size options.

Biomass Stove/Grills and Space Heaters

- Full-featured units for affluent societies
- Basic unit US$300
- Many optional features

Biomass Stove/Grills and Space Heaters

- Basic-featured units for low-income users
- Basic unit US$150 in America
- Many optional features to increase lifespan and user convenience

Cooking Capabilities

- Each stove is capable of preparing full meals.

Eggs

Sweet Corn

Chicken & boiled potatoes

Chip Energy is freely sharing the updraft gasification technology to accomplish the international goals for clean indoor air.

For projects involving commercialization and/or grants, we would appreciate the opportunity to work with you.