ADVENTURES in Electricity

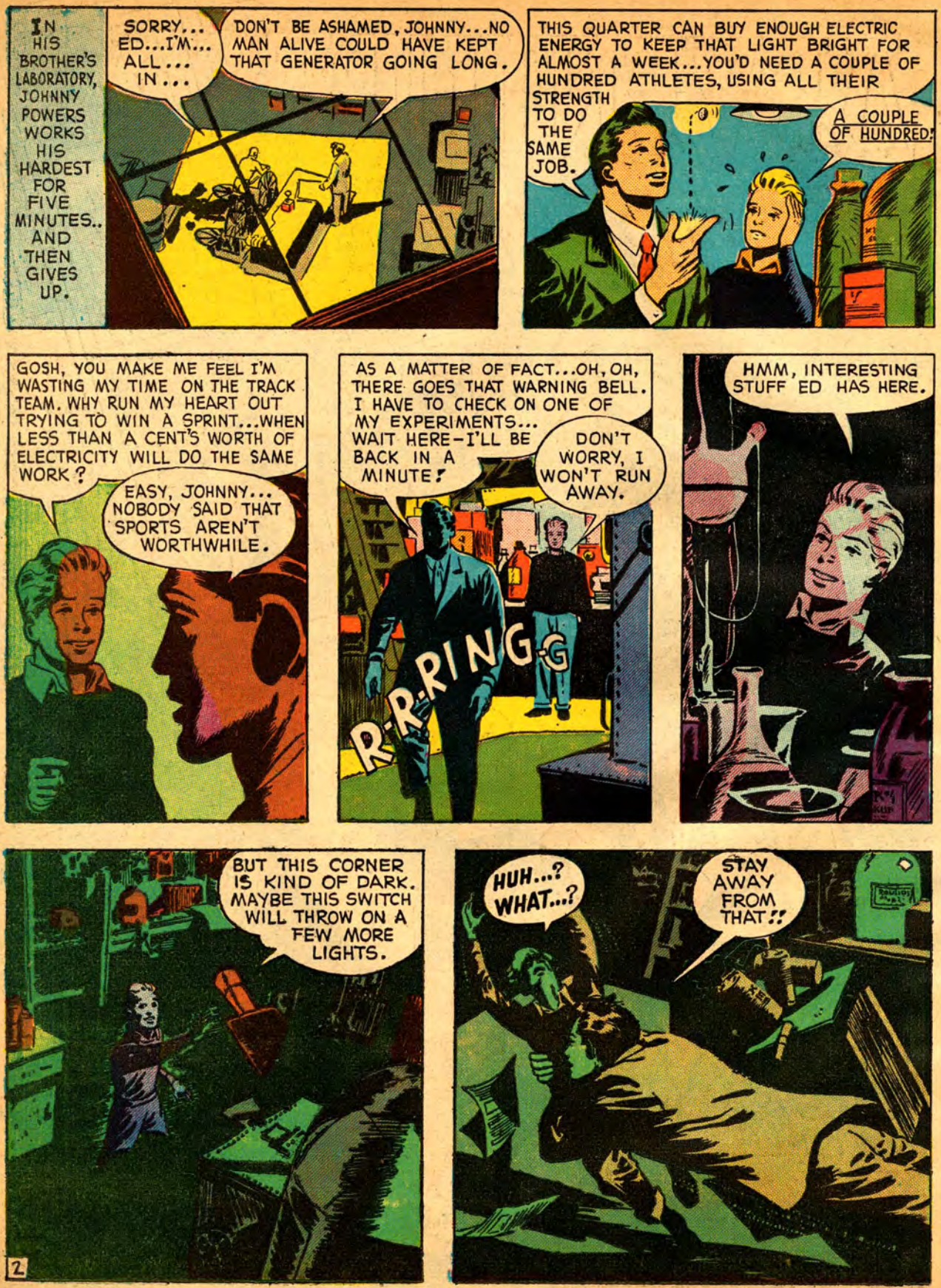
Scientists have learned to tap the stored energy of the sun . . . to flash it thousands of miles in a fraction of a second . . . and to perform modern miracles that put to shame the fabled magic of the Arabian Nights. What is this strange and marvelous force? How do we control the monstrous power we unloose? The answer's in this exciting tale of

"HOW MAGIC IS BORN . . . AND HOW IT TRAVELS!"

ADVENTURE SERIES

Prepared for
GENERAL ELECTRIC COMPANY
By GENERAL COMICS, Inc.

THE GENERATION AND TRANSMISSION OF ELECTRICITY


IN HIS BROTHER'S LABORATORY, JOHNNY POWERS WORKS HIS HARDEST FOR FIVE MINUTES.. AND THEN GIVES UP.
SORRY... ED...I'M... ALL... IN...
DON'T BE ASHAMED, JOHNNY...NO MAN ALIVE COULD HAVE KEPT THAT GENERATOR GOING LONG.
THIS QUARTER CAN BUY ENOUGH ELECTRIC ENERGY TO KEEP THAT LIGHT BRIGHT FOR ALMOST A WEEK...YOU'D NEED A COUPLE OF HUNDRED ATHLETES, USING ALL THEIR STRENGTH TO DO THE SAME JOB.
A COUPLE OF HUNDRED!
GOSH, YOU MAKE ME FEEL I'M WASTING MY TIME ON THE TRACK TEAM. WHY RUN MY HEART OUT TRYING TO WIN A SPRINT...WHEN LESS THAN A CENT'S WORTH OF ELECTRICITY WILL DO THE SAME WORK?
EASY, JOHNNY... NOBODY SAID THAT SPORTS AREN'T WORTHWHILE.
AS A MATTER OF FACT...OH, OH, THERE GOES THAT WARNING BELL. I HAVE TO CHECK ON ONE OF MY EXPERIMENTS... WAIT HERE—I'LL BE BACK IN A MINUTE!
DON'T WORRY, I WON'T RUN AWAY.
R-R-RING-G
HMM, INTERESTING STUFF ED HAS HERE.
BUT THIS CORNER IS KIND OF DARK. MAYBE THIS SWITCH WILL THROW ON A FEW MORE LIGHTS.
HUH...? WHAT...?
STAY AWAY FROM THAT!!
2

WHEW! THAT WAS CLOSE! THAT SWITCH CONTROLS FOUR THOUSAND VOLTS. I HATE TO THINK WHAT WOULD HAVE HAPPENED TO MY EXPERIMENT IF YOU HAD THROWN IT!

GOSH, ED, IT'S LUCKY YOU STILL REMEMBER HOW TO MAKE A FLYING TACKLE.

"IT SURE IS. GUESS MY FOOTBALL DAYS WEREN'T WASTED AFTER ALL. I'M GLAD I TOOK TIME OUT FROM SCIENCE."

RAH, RAH, RAH

THE FACT THAT ELECTRICITY COULD HAVE MADE THE SAME TOUCHDOWN CHEAPER DIDN'T WORRY ME! WE GO IN FOR SPORTS FOR THE FUN OF IT.

I KNOW...ALL THE SAME I WISH IT WAS AS EASY TO RUN A MILE AS TO TURN ON THE LIGHTS. JUST PRESS A BUTTON, AND—ABRACADABRA—THEY'RE ON.

BET IT WOULD TAKE MILLIONS OF MEN TO KEEP THEM BURNING ALL OVER THE COUNTRY, WOULDN'T IT?

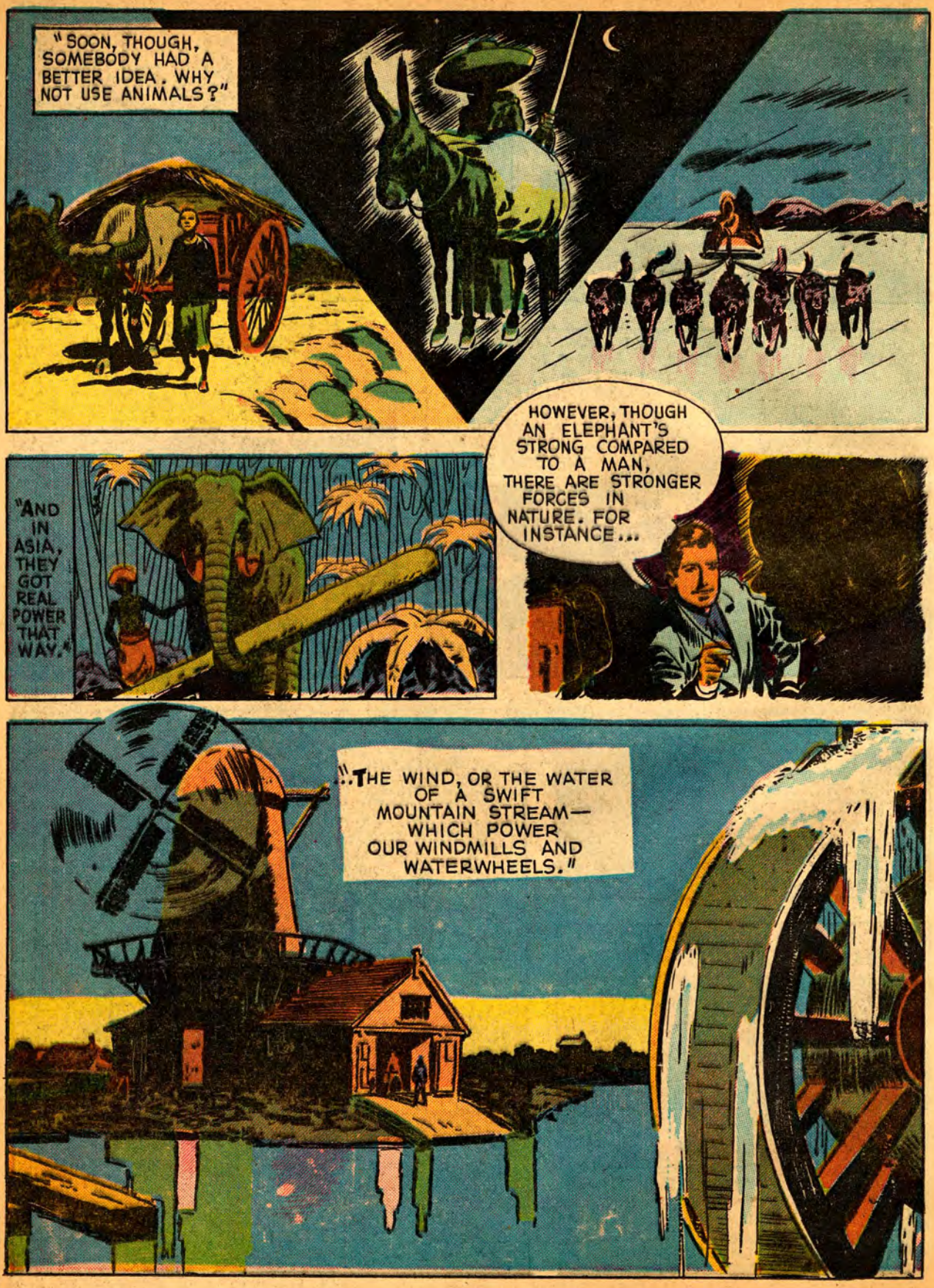
MORE MILLIONS THAN THERE ARE IN THE WHOLE WORLD! YOU SEE, JOHNNY, THE TRICK IS TO USE A SUBSTITUTE FOR HUMAN ENERGY WHENEVER WE CAN.

IN FACT, ALL THROUGH HISTORY, MAN HAS FOUND THAT THE LESS OF HIS OWN ENERGY HE USES, AND THE MORE OF OTHER KINDS...THE MORE HE GETS DONE!

"IN CAVE-MAN DAYS, HE HAD NO CHOICE--HE HAD TO USE HIS OWN MUSCLES."

"WHEN HE HAD TO CARRY SOMETHING HEAVY, LIKE A BIG DEER, HE JUST COULDN'T."

"AFTER A TIME, HE DID SUCCEED IN HANDLING HEAVY OBJECTS... BUT ONLY AT THE EXPENSE OF OTHER MEN, HIS SLAVES."


"SOON, THOUGH, SOMEBODY HAD A BETTER IDEA. WHY NOT USE ANIMALS?"
"AND IN ASIA, THEY GOT REAL POWER THAT WAY."
HOWEVER, THOUGH AN ELEPHANT'S STRONG COMPARED TO A MAN, THERE ARE STRONGER FORCES IN NATURE. FOR INSTANCE...
"...THE WIND, OR THE WATER OF A SWIFT MOUNTAIN STREAM— WHICH POWER OUR WINDMILLS AND WATERWHEELS."

"YES, MEN THOUGHT OF A LOT OF WAYS TO GET MORE POWER. EVENTUALLY, ONE GENIUS, JAMES WATT, INVENTED A SENSATIONAL NEW WAY OF DOING IT...THE STEAM ENGINE."

WATT USED THE ENERGY NATURE HAD STORED UP IN COAL. WE USE IT TOO...BUT WE HAVE AN EVEN BETTER WAY OF DOING IT, ONE HE NEVER DREAMED OF! COME ON, JOHNNY, I'LL SHOW YOU.

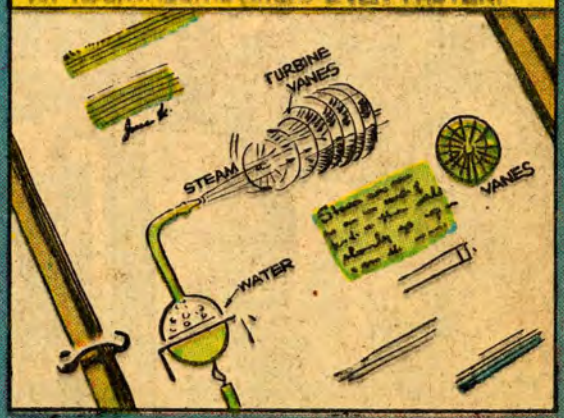
A POWERHOUSE COULD RUN ON WATER POWER... ACTUALLY, THIS ONE USES COAL... THREE QUARTERS OF ALL THE ELECTRIC ENERGY IN THE UNITED STATES IS PRODUCED BY BURNING FUEL.

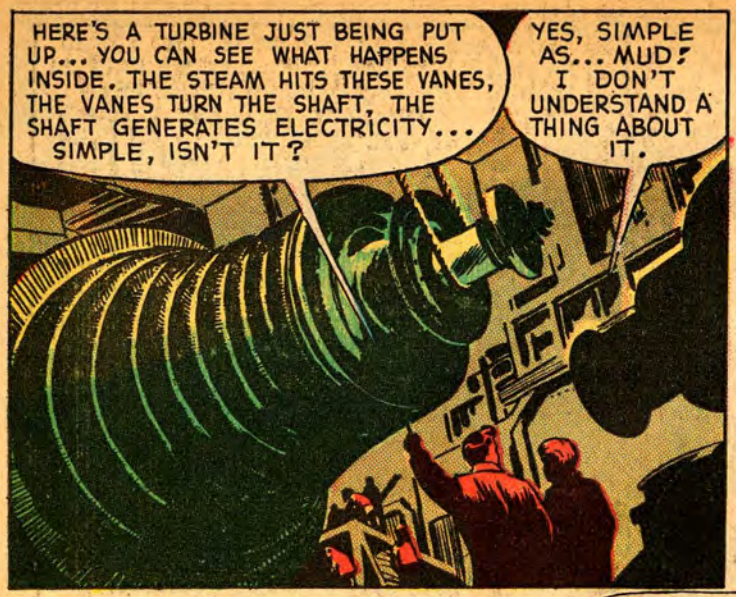
THIS IS A GENERATOR UNIT SO BIG THAT IT SUPPLIES AS MUCH POWER AS A MILLION MEN.

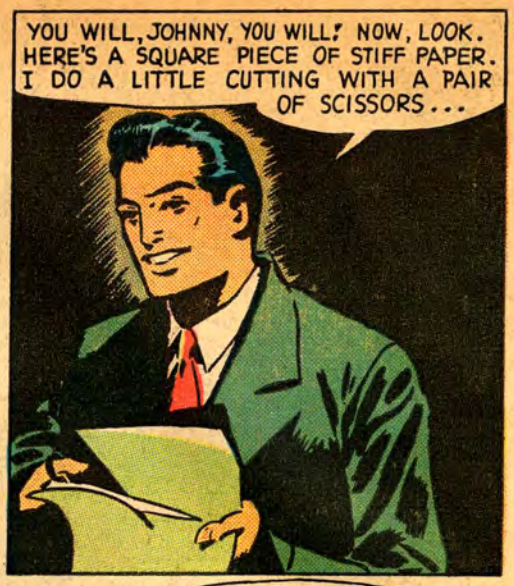
A MILLION MEN... WOW!

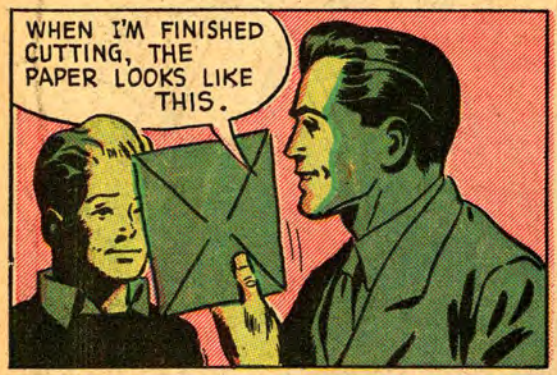
AS I TOLD YOU, WE START BY BURNING COAL UNDER A BOILER.. ..LOOK, I'LL SHOW YOU...

"THE COAL HEATS WATER AND TURNS IT TO STEAM SO HOT IT'LL MAKE IRON GLOW RED. THE STEAM RUSHES INTO THIS TURBINE AT FIVE OR SIX HUNDRED MILES AN HOUR...SOMETIMES EVEN FASTER."




HERE'S A TURBINE JUST BEING PUT UP... YOU CAN SEE WHAT HAPPENS INSIDE. THE STEAM HITS THESE VANES, THE VANES TURN THE SHAFT, THE SHAFT GENERATES ELECTRICITY... SIMPLE, ISN'T IT?
YES, SIMPLE AS... MUD! I DON'T UNDERSTAND A THING ABOUT IT.


YOU WILL, JOHNNY, YOU WILL! NOW, LOOK. HERE'S A SQUARE PIECE OF STIFF PAPER. I DO A LITTLE CUTTING WITH A PAIR OF SCISSORS...


WHEN I'M FINISHED CUTTING, THE PAPER LOOKS LIKE THIS.


SIMPLE ENOUGH SO FAR?
AND HOW! I KNOW WHAT YOU'RE MAKING...


IT'S A PINWHEEL! I'VE MADE PLENTY MYSELF!
SO HAVE I... BEFORE YOU WERE BORN.


NOW I BLOW AGAINST IT...
AND IT TURNS. SO WHAT?

NOTHING... EXCEPT THAT THIS TURBINE VANE IS BASED ON THE SAME PRINCIPLE THAT MAKES A WINDMILL OPERATE.

HUH..? IT'S AS SIMPLE AS THAT?

"OF COURSE! THE STEAM HITS THE VANE THE SAME WAY YOUR BREATH HIT THE PINWHEEL... LOOK, I'LL DRAW IT FOR YOU...

STEAM

VANES

SHAFT

"THE FIRST VANES SLOW THE STEAM DOWN A BIT...BUT THE STEAM IS STILL MOVING PLENTY FAST. SO WE ADD ANOTHER SET OF VANES BEHIND THE FIRST..."

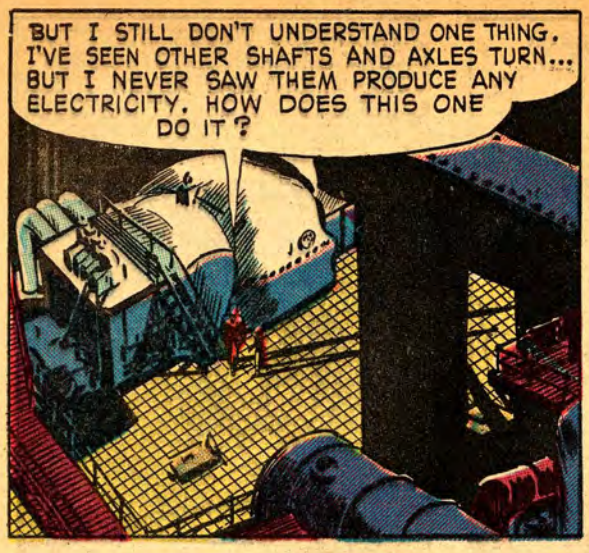
"AND THEN ANOTHER AND ANOTHER."

"WELL, JOHNNY, THAT'S EXACTLY WHAT GOES ON INSIDE A TURBINE."

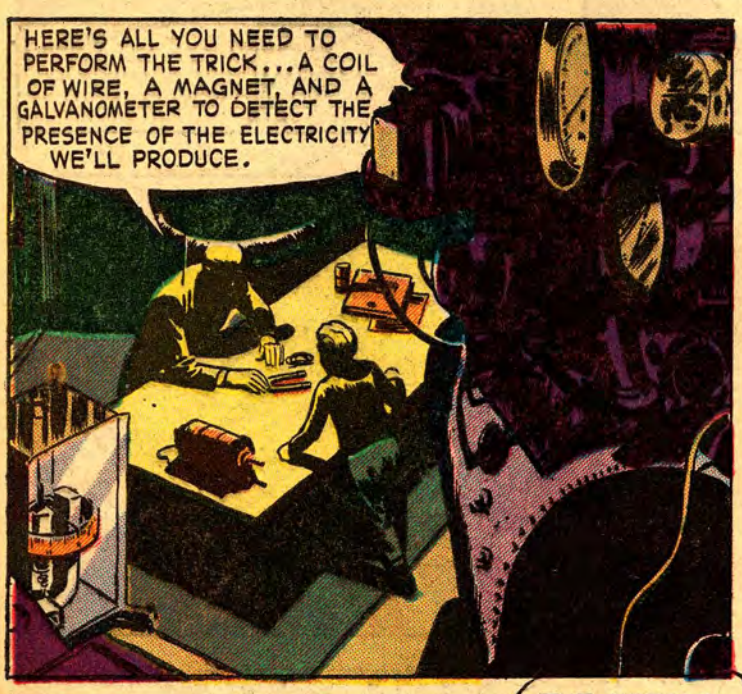
ALL THAT HAPPENS IS THAT THE ENERGY WE START WITH IN THE COAL IS CONVERTED INTO A DIFFERENT FORM... IT'S MADE TO TURN THE SHAFT.

I GET IT. AND I UNDERSTAND, TOO, WHY YOU SAID BEFORE THAT WE COULD USE WATERPOWER INSTEAD OF COAL...

I THOUGHT YOU WOULD, JOHNNY. SO LONG AS YOU GET THE SHAFT TURNING, IT DOESN'T MATTER WHERE THE ENERGY CAME FROM IN THE FIRST PLACE.


BUT I STILL DON'T UNDERSTAND ONE THING. I'VE SEEN OTHER SHAFTS AND AXLES TURN... BUT I NEVER SAW THEM PRODUCE ANY ELECTRICITY. HOW DOES THIS ONE DO IT?


"JOHNNY, THAT'S A SECRET THAT'S BEEN WORTH BILLIONS OF DOLLARS TO THE HUMAN RACE... BUT, SINCE YOU'RE MY BROTHER, YOU CAN HAVE IT FREE."


HERE'S ALL YOU NEED TO PERFORM THE TRICK... A COIL OF WIRE, A MAGNET, AND A GALVANOMETER TO DETECT THE PRESENCE OF THE ELECTRICITY WE'LL PRODUCE.


I CONNECT THE COIL TO THE GALVANOMETER AND PUT THE COIL BETWEEN THE ENDS OF THE MAGNET...


NOW I TURN THE COIL SLOWLY...
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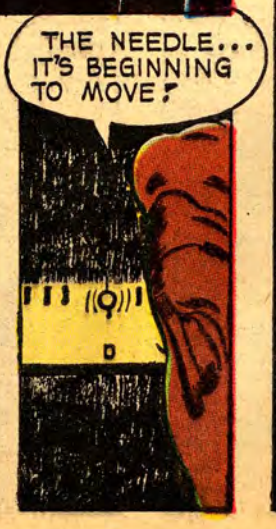

THE NEEDLE... IT'S BEGINNING TO MOVE!


AND AS I ROTATE THE COIL FASTER...
THE NEEDLE'S MOVING MORE AND MORE!


NATURALLY--THE FASTER I TURN THE COIL, THE MORE ELECTRICITY GOES THROUGH THE WIRE.
GOSH, IS THAT ALL THERE IS TO MAKING ELECTRICITY? I THOUGHT IT WAS COMPLICATED!
IT IS COMPLICATED, JOHNNY, WHEN YOU TRY TO GET A CURRENT LARGE ENOUGH TO BE USEFUL. NO MATTER HOW FAST YOU TURN THAT COIL IN THE MAGNET, YOU'LL NEVER PRODUCE ENOUGH ELECTRICITY TO LIGHT EVEN A TINY BULB LIKE THIS.
"NEVERTHELESS, THE GENERATOR WORKS ON THE SAME PRINCIPLE AS OUR LITTLE EXPERIMENT. IT USES A STEAM TURBINE INSTEAD OF A HUMAN HAND TO PRODUCE MOTION... AND GIANT MAGNETS AND COILS INSTEAD OF OUR SMALL ONES..."
AND INSTEAD OF PRODUCING A TINY CURRENT LIKE THE ONE WE PRODUCED, GENERATORS MAKE ENOUGH ELECTRICITY TO LIGHT UP A GREAT CITY!"
ALL DONE WITH A PIECE OF WIRE AND A MAGNET! IT'S SIMPLE... BUT IT'S SURE BAFFLING, TOO!
NOT SO BAFFLING AS IT SEEMS AT FIRST, JOHNNY!
"MAGNIFY THE WIRE A COUPLE OF BILLION BILLION TIMES AND YOU WON'T SEE THIS."
"ELECTRONS DON'T REALLY LOOK LIKE THIS, OF COURSE, BUT I'M DRAWING THEM MORE HUMAN HERE TO SHOW YOU WHAT HAPPENS. THEY'RE VERY TINY."

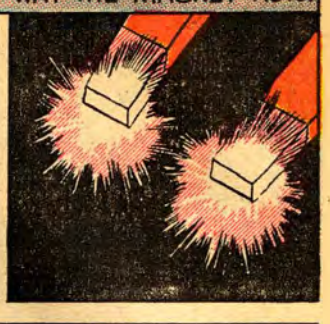
"MOST OF THE TIME, EVEN IF THEY MOVE AROUND A LITTLE THEY DON'T CONTRIBUTE TO THE CURRENT."

"BUT BRING A MAGNET NEAR THEM... AND THINGS HAPPEN."

WATCH OUT, BOYS... HERE COMES A MAGNET!

HEY? WHAT..?

"WE CAN IMAGINE THE END OF THE MAGNET SURROUNDED WITH INVISIBLE LINES OF FORCE. ACTUALLY, THEY DON'T EXIST AS LINES, BUT THEY DO REPRESENT THE WAY THE MAGNET ACTS.



"AND WHEN THEY HIT THE ELECTRONS...

OWWW... WE BETTER GET OUT OF HERE!

"BUT FOR THAT TO HAPPEN, THE MAGNET OR THE WIRE HAS TO BE KEPT MOVING. BECAUSE, IF NEITHER ONE MOVES, WE DON'T GET A CURRENT, EVEN THOUGH THE LINES OF FORCE ARE STILL THERE."

HANG AROUND, FELLOWS... THIS THING'S DEAD AND IT WON'T HURT US!

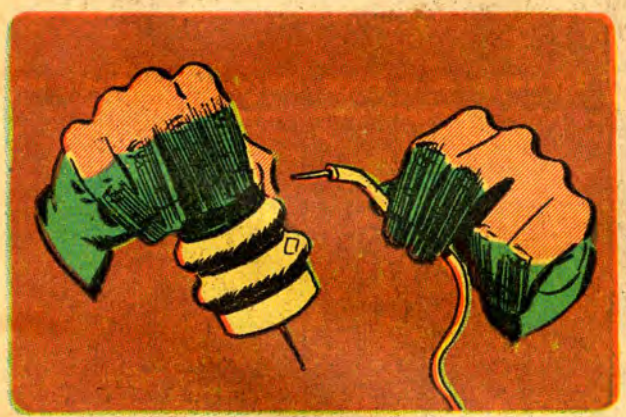
"IS THAT CLEAR, JOHNNY? YOU NEED BOTH A MAGNETIC FIELD AND MOTION TO PRODUCE A CURRENT."

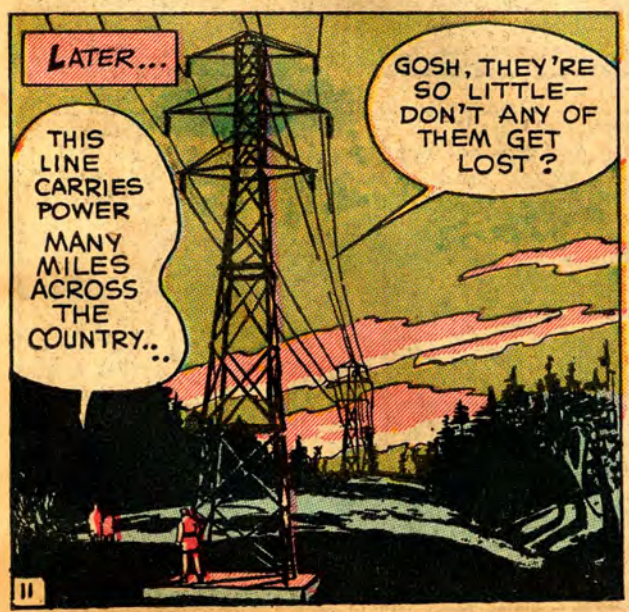
BUT WHEN ALL THE ELECTRONS CHASE OFF DOWN THE WIRE.. ..WHAT THEN? WHERE DOES THE ELECTRIC CURRENT COME FROM?

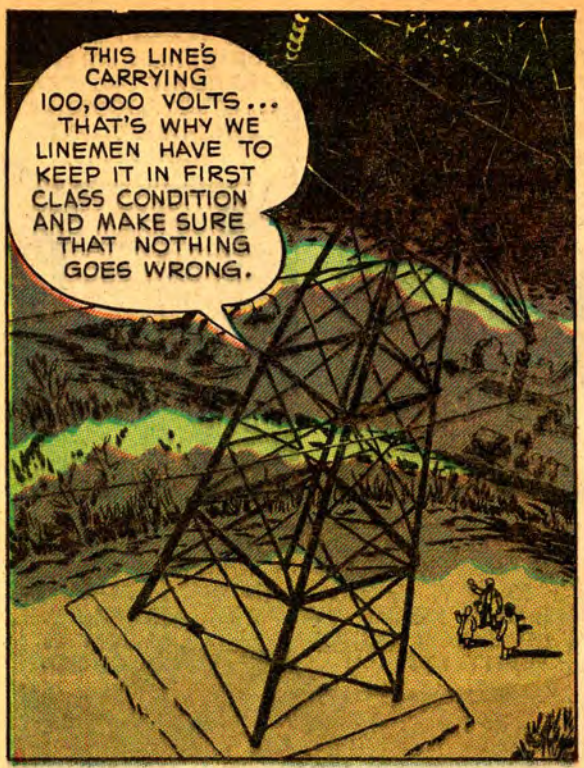
THAT'S IT, JOHNNY.. AN ORDINARY ELECTRIC CURRENT IS NOTHING BUT A BUNCH OF MOVING ELECTRONS.

OF COURSE, ONCE THEY'RE MOVING WE CAN COAX THEM TO GO WHEREVER WE WANT... THUS TRANSMITTING CURRENT WHEREVER WE NEED IT. LET ME SHOW YOU HOW.

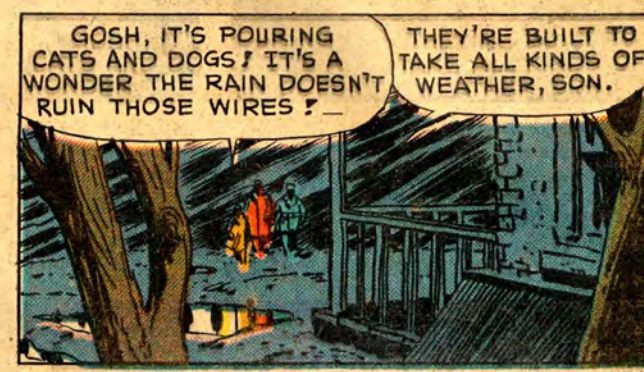
WHEN ELECTRIC CURRENTS START RUNNING WILD, THEY CAN BE MIGHTY DANGEROUS. SO WE USE FLEXIBLE RUBBER INSULATION FOR THE WIRE ITSELF, GLASS OR PORCELAIN FOR SUPPORTS.






THIS LINE'S CARRYING 100,000 VOLTS... THAT'S WHY WE LINEMEN HAVE TO KEEP IT IN FIRST CLASS CONDITION AND MAKE SURE THAT NOTHING GOES WRONG.


AND 100,000 VOLTS IS NOT TOPS, EITHER! BUT IT'S BEGINNING TO RAIN...WE'D BETTER FIND SOME SHELTER!


GOSH, IT'S POURING CATS AND DOGS! IT'S A WONDER THE RAIN DOESN'T RUIN THOSE WIRES!
THEY'RE BUILT TO TAKE ALL KINDS OF WEATHER, SON.


THAT LIGHTNING MUST HAVE HIT CLOSE! I WONDER HOW MANY VOLTS IN THAT?


ABOUT FIFTY OR A HUNDRED MILLION, JOHNNY.
WHAT?
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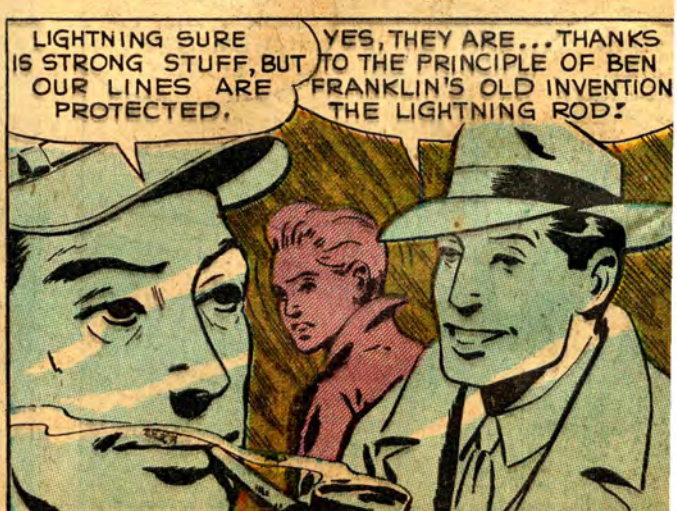
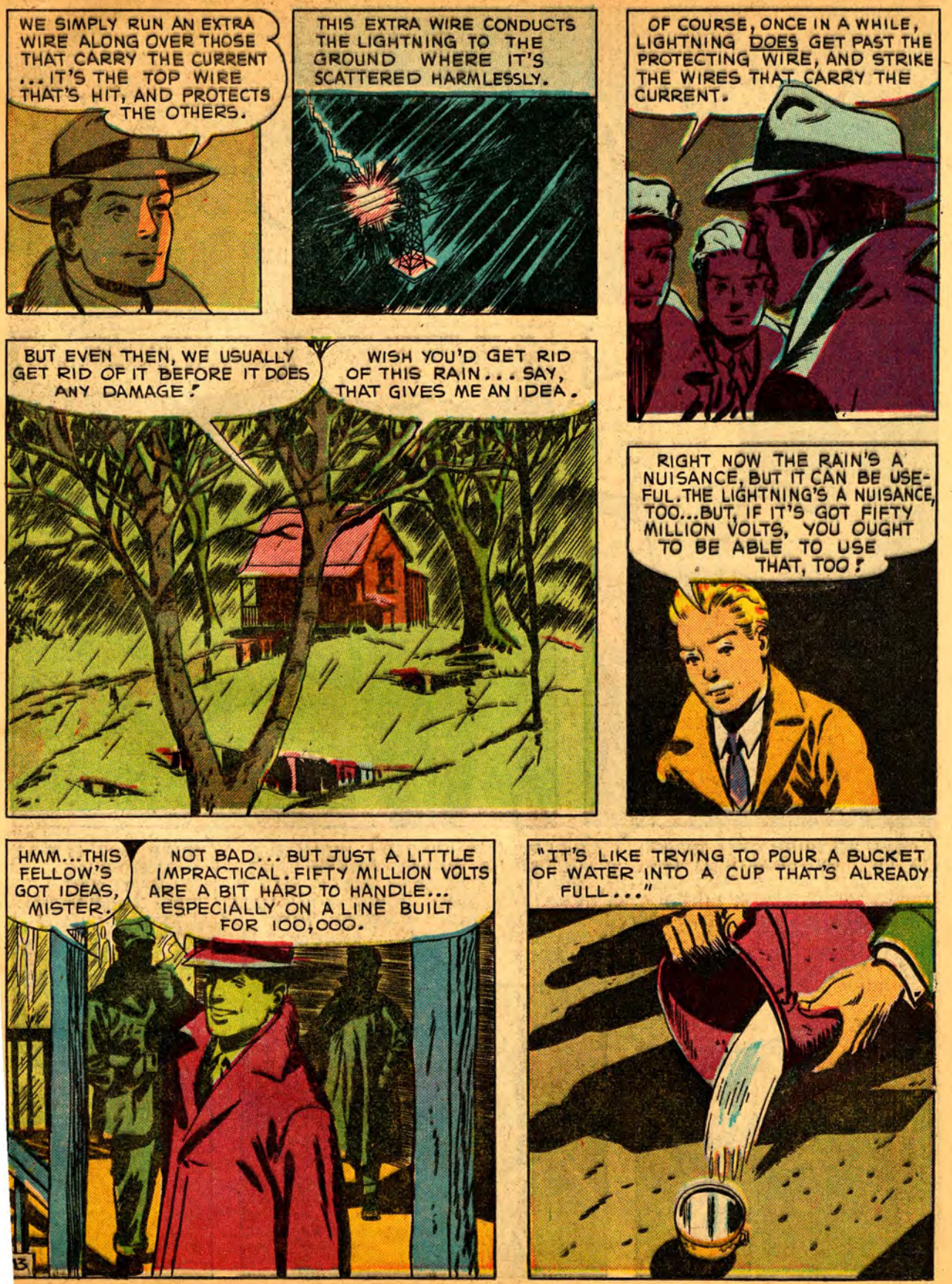
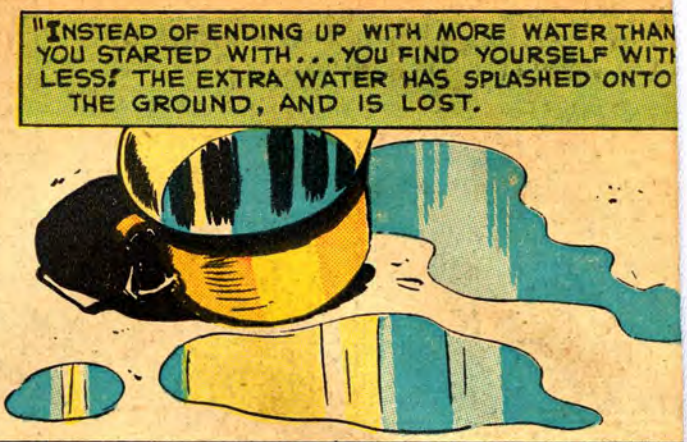

LIGHTNING SURE IS STRONG STUFF, BUT OUR LINES ARE PROTECTED.
YES, THEY ARE...THANKS TO THE PRINCIPLE OF BEN FRANKLIN'S OLD INVENTION THE LIGHTNING ROD!


WE SIMPLY RUN AN EXTRA WIRE ALONG OVER THOSE THAT CARRY THE CURRENT ... IT'S THE TOP WIRE THAT'S HIT, AND PROTECTS THE OTHERS.
THIS EXTRA WIRE CONDUCTS THE LIGHTNING TO THE GROUND WHERE IT'S SCATTERED HARMLESSLY.
OF COURSE, ONCE IN A WHILE, LIGHTNING DOES GET PAST THE PROTECTING WIRE, AND STRIKE THE WIRES THAT CARRY THE CURRENT.
BUT EVEN THEN, WE USUALLY GET RID OF IT BEFORE IT DOES ANY DAMAGE!
WISH YOU'D GET RID OF THIS RAIN... SAY, THAT GIVES ME AN IDEA.
RIGHT NOW THE RAIN'S A NUISANCE, BUT IT CAN BE USEFUL. THE LIGHTNING'S A NUISANCE, TOO... BUT, IF IT'S GOT FIFTY MILLION VOLTS, YOU OUGHT TO BE ABLE TO USE THAT, TOO!
HMM... THIS FELLOW'S GOT IDEAS, MISTER.
NOT BAD... BUT JUST A LITTLE IMPRACTICAL. FIFTY MILLION VOLTS ARE A BIT HARD TO HANDLE... ESPECIALLY ON A LINE BUILT FOR 100,000.
"IT'S LIKE TRYING TO POUR A BUCKET OF WATER INTO A CUP THAT'S ALREADY FULL..."


SPLASH


"INSTEAD OF ENDING UP WITH MORE WATER THAN YOU STARTED WITH... YOU FIND YOURSELF WITH LESS! THE EXTRA WATER HAS SPLASHED ONTO THE GROUND, AND IS LOST.


THAT'S THE KIND OF THING THAT HAPPENS WHEN LIGHTNING HITS A LINE THAT'S ALREADY LOADED.
GUESS YOU'RE RIGHT, MISTER. BUT THE RAIN'S STOPPING...


SO I'D BETTER SEE ABOUT GETTING BACK TO WORK. SO LONG.
SO LONG... AND THANKS FOR EXPLAINING THINGS.


COME TO THINK OF IT, THOUGH, HE LEFT OUT SOMETHING IMPORTANT... AND SO DID YOU. THESE HIGH-TENSION LINES ARE INTERESTING...BUT HOW ABOUT THE WIRES THAT CARRY THE CURRENT IN OUR HOUSES? WHAT ABOUT THEM?
THEY'RE PART OF THE SAME STORY, JOHNNY.


THESE SAME 100,000 VOLT LINES SUPPLY CURRENT TO OUR TOASTERS, AND RADIOS, AND ELECTRIC LIGHTS.
HUH.? BUT THOSE TAKE JUST A LITTLE OVER A HUNDRED VOLTS, NOT 100,000!


SURE, BUT IT'S THE SAME ELECTRICITY. IT'S JUST BEEN STEPPED DOWN TO LOWER VOLTAGE.

"IT'S LIKE TRYING TO GET A PIECE OF CANDY FROM A MACHINE BY PUTTING A BIG BILL IN THE SLOT..."

HEY, MISTER! THAT SLOT TAKES JUST NICKELS!

"YOU HAVE TO GET THE BILL CHANGED INTO NICKELS. IT'S THE SAME WAY WITH ELECTRICITY... YOU CHANGE 100,000 VOLT CURRENT TO 120 VOLT, OR 240, OR WHATEVER YOU WANT. THE THING YOU DO IT WITH IS A SERIES OF TRANSFORMERS..."

"YOU CAN HAVE A GIANT TRANSFORMER, A MIDGET, OR ANYTHING IN BETWEEN, DEPENDING ON WHAT YOU NEED IT FOR..."

"BUT THEY ALL DO THE JOB EFFICIENTLY, WITH THE LOSS OF PRACTICALLY NO POWER.

GOSH, THAT LITTLE THING SURE DOES AN IMPORTANT JOB... BUT I'D NEVER THOUGHT IT.

YES, YOU CAN'T TELL FROM THE WAY A GADGET LOOKS JUST HOW IMPORTANT IT IS.

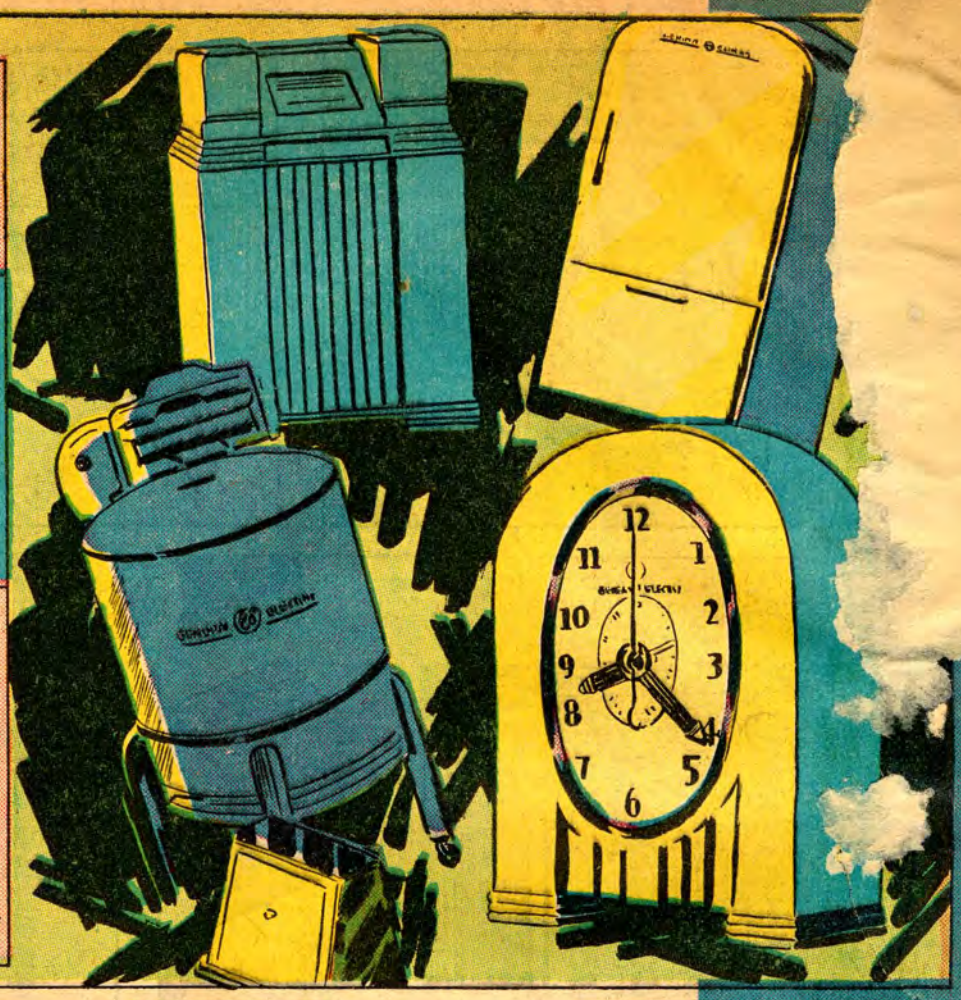
"TAKE AN ELECTRIC METER, FOR INSTANCE. LOOKS SIMPLE, DOESN'T IT? YET IT MEASURES CURRENT AND VOLTAGE AT THE SAME TIME, MULTIPLIES THEM TOGETHER, MULTIPLIES BY THE TIME THE CURRENT IS ON..."

"AND GIVES YOU THE ANSWER INSTANTLY IN TERMS OF KILOWATT-HOURS OF ENERGY USED."

"OR TAKE AN ORDINARY FUSE. THAT LOOKS SIMPLE TOO... BUT IT DOES A SWELL JOB OF PROTECTING YOUR HOUSE AGAINST DAMAGE IF ANYTHING GOES WRONG WITH THE CIRCUIT..."

"SUPPOSE YOU HAVE A SHORT CIRCUIT, FOR INSTANCE. POP, GOES THE FUSE... AND POP GOES EVERY FUSE YOU PUT IN ITS PLACE, UNTIL THE TROUBLE IS CORRECTED."

"IT'S LITTLE GADGETS LIKE THAT, JOHNNY, THAT MAKE IT POSSIBLE FOR US TO USE ALL THE MARVELOUS THINGS THAT RUN BY MEANS OF ELECTRICITY... ELECTRIC EYES, LAMPS, CLOCKS HEATERS, MOTORS, RADIOS, WASHING MACHINES, REFRIGERATORS..."



GEE, COME TO THINK OF IT, THEY ARE PRETTY WONDERFUL. I'M GLAD YOU TOLD ME ALL THIS, ED. I'VE ALWAYS WANTED TO KNOW ALL ABOUT ELECTRICITY.

ALL ABOUT IT? JOHNNY, YOU'VE LEARNED A LOT! BUT....

NO MAN KNOWS ALL ABOUT ELECTRICITY. THERE'S AN OCEAN OF UNKNOWN FACTS AHEAD OF US... AND WE'VE JUST ABOUT GOT OUR FEET WET IN THE WATER.

WI
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THINK I'VE
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GENERAL ELECTRIC
Schenectady, New York

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